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ABSTRACT

This study sought to examine the relationship between five methods of test preparation and test performance as measured by Graduate Management Admission Test (GMAT) Verbal, Quantitative and Total scores. Data on method of test preparation were obtained through voluntary examinee response to five questions which appeared on the answer sheets. One sample of first-time test takers and one sample of second-time test takers were selected from among the 185,525 1981-82 GMAT examinees who were U.S. citizens. Multiple regressions using GMAT scores as dependent variables and test preparation, undergraduate grade point average (UGPA) and sex as independent variables were computed separately for first-time examinees who were members of the Afro-American/Black, Caucasion/White, Oriental/Asian and Spanish-American U.S. citizen subgroups. Results indicated that differences in GMAT scores do exist among examinees using different methods of preparing for the examination. However, it was shown that when initial ability, as measured by GMAT first score, was controlled, the sizes of the effects of studying the GMAT bulletin, working through an actual GMAT, and reviewing mathematics were not significantly different from zero. The effects of the methods on GMAT scores of first-time examinees were larger. However, the effects of test preparation are confounded with the characteristics of examinees who choose to use each method. (Author/BW)

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Estimating the Relationship between Use of Test-Preparation Methods and Scores on the Graduate Management Admission Test

Linda F. Leary
Lawrence E. Wightman

GMAC Research Report 83-1
ETS Research Report RR-83-22

TM 830629

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June 1983

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ABSTRACT

This study sought to examine the relationship between five methods of test preparation and test performance as measured by Graduate Management Admission Test (GMAT) Verbal (V), Quantitative (Q) and Total (T) scores. Data on method of test preparation were obtained through voluntary examinee response to the following five questions which appeared on the answer sheets:

In preparing for this test, did you:
1. Study the sample questions in the GMAT registration bulletin?
2. Work through an actual GMAT published by ETS?
3. Use a book not published by ETS on how to prepare for the GMAT?
4. Attend a test preparation or coaching course for the GMAT?
5. Undertake on your own any review of mathematics?

One sample of first-time test takers and one sample of second-time test takers were selected from among the 185,525 1981-82 GMAT examinees who were U.S. citizens. Multiple regressions using GMAT scores as dependent variables and test preparation, undergraduate grade point average (UGPA) and sex as independent variables were computed separately for first-time examinees who were members of the Afro-American/Black, Caucasion/White, Oriental/Asian and Spanish-American U.S. citizen subgroups. Regressions (including first GMAT scores as independent variables) were also computed for all examinees in the sample who were taking the GMAT for the second time.

First-time Examinees

The percents of first-time examinees electing to use each method varied, but the rank order of the frequency of using each method was consistent across the subgroups. The largest proportion of first-time examinees reported that they had prepared by reviewing the bulletin, followed in descending order by using a test preparation book not prepared by ETS, undertaking their own study of mathematics, working through an actual GMAT, and attending a test preparation course. The study also found that examinees electing to use the various methods of preparation did not differ appreciably in previous academic performance as measured by undergraduate grade point average, but did vary slightly in age and amount of work experience.

Results of the multiple regression analyses based on data from first-time examinees differed across the four subgroups. The size of the coefficients associated with each method of preparation, as well as the corresponding standard errors, varied among the four subgroups. The same was true for the interaction effects between pairs of methods. The expected difference in verbal score for a "yes" response to "Studying a test review book not published by ETS" when the effects of the other independent variables were held constant, ranged from 1.6 to 3.2 scaled score points and were significant for all four subgroups. The difference in verbal scores for "Studying the Bulletin" ranged from 1.3 scaled score points for Afro-American/Blacks to 4.0 scaled points for Oriental/Asians. The effects of using a review book or taking a review course ranged between .4 and 1.9 points on verbal and quantitative scores. Negative effects were associated with examinees' own review of mathematics. These effects were attributed to a confounding between self-selection and metnod of preparation.

Second-time Examinees

The sizes of the effects associated with each method of preparation for second-time examinees were considerably less than those obtained using data from first-time examinees. When previous test performance was held constant, the effect of using each of the methods of preparation was small. In fact, only the effects of using a test preparation book and of attending a test preparation course were significantly different from zero.

The mean GMAT scores between second-time examinees who did and did not use each method of preparation differed inconsistently and only slightly. Additionally, the magnitude of gain over the first administration score was very similar between examinees who used and did not use each method.

Conclusions

This study has indicated that differences in GMAT scores do exist among examinees using different methods of preparing for the examination. However, it was shown that when initial ability, as measured by GMAT first score, was controlled, the sizes of the effects of studying the GMAT bulletin, working through an actual GMAT, and reviewing mathematics were not significantly different from zero. The effects of the methods on GMAT scores of first-time examinees, for whom a previous score was not available to use as a covariate, were larger. In those analyses (in which self-reported UGPA was used as a less effective control on ability), the largest effects associated with any method over the other were about 4, 3 and 33 verbal, quantitative and total score points, respectively. However, the effects of using these methods are confounded with the characteristics of examinees who choose to use each method. The effects resulted from a combination of self-selection and preparation. There do appear to be relationships between method of preparation and test scores. However, it must be emphasized that it does not necessarily follow that using any of the methods of preparation causes an increase in scores.

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INTRODUCTION

This study was undertaken in order to estimate the relationship of various methods of test preparation to Graduate Management Admission Test (GMAT) scores. The effects of special test preparation, particularly the effects of coaching courses, have been of concern in many large-scale testing programs. However, most previous investigations of the effects of test preparation have focused on the Scholastic Aptitude Test (SAT) (e.g., Alderman and Powers, 1980; Coffman & Parry, 1967; Evans and Pike, 1973; Federal Trade Commission, 1979; Frankel, 1960; Marron, 1965; Messick, 1980; Powers, 1982). Investigations of the Graduate Record Examination (Alderman and Powers, 1980; Powers and Swinton, 1982; Swinton and Powers, in press) identified certain item types that were coachable, which led to modified testing procedures in that program.

Research concerning methods of test preparation initially addresses the question of the relationship of each of the individual methods to subsequent test performance. Further consideration of the problem increases the complexity of the investigation. For example, particular methods of test preparation are self selected by the examinees themselves. Characteristics of examinees such as motivation, ability and socioeconomic status may affect their choice of method of preparation. In addition to this self selection, test preparation methods may differentially affect test performance as a result of individual characteristics of the examinees. Novick (1982) suggests that different regressions may be necessary in order to articulate the relationship of the same set of independent variables to the same dependent variable for persons who are members of different (and not exchangeable) subpopulations. Messick (1980) has also advocated that studies of the possible differential effectiveness of coaching should be done with native American, Mexican American, Asian American, Puerto Rican, Black and White samples. Finally, research on test preparation methods is complicated by the fact that examinees tend to undertake more than one method of preparing for examinations (Powers, 1981; Powers and Hecht, 1981). Possible interactions between the various methods should therefore also be considered.

PROCEDURE

Data Collection

During the October 1981 through June 1982 testing year, the following five questions pertaining to methods of preparation for the Graduate Management Admission Test appeared on the answer sheets.

In preparing for this test, did you:

1. Study the sample questions in the GMAT registration bulletin?
2. Work through an actual GMAT published by ETS?
3. Use a book not published by ETS on how to prepare for the GMAT?
4. Attend a test preparation or coaching course for the GMAT?
5. Undertake on your own any review of mathematics?

Each examinee who chose to answer the test preparation research questions gridded his/her answer sheet either "yes" or "no" to indicate whether each method of preparation was undertaken. From among the 185,525 records of "on-time"[1] answer sheets from the four 1981-82 GMAT test administrations (October, January, March and June), two separate samples were selected. One sample consisted only of 1981-82 examinees who were taking the GMAT for the first time, the other sample consisted only of examinees taking the GMAT for the second time in 1981-82. Only examinees who responded to at least one of the research questions were included in this study. It was assumed that for candidates with at least one response, the remaining non-responses were a "no". GMAT verbal, quantitative and total scores were available for each examinee in the sample. Additional background information including sex, citizenship, population subgroup if a U. S. citizen, and self-reported undergraduate grade point average was obtained from voluntary responses by examinees to a nine-item Biographical Information Questionnaire which was part of the 1981-82 registration form. In the case of second-time test takers, GMAT

[1]The computer tape files consisted of examinees whose answer sheets were received and processed by a specified date in the processing schedule, thus the term "on-time." Normally this includes 90 to 95 percent of all examinees attending the administration.

verbal, quantitative and total first-time scores were available for each examinee.

Method of Analysis

Multiple regression analysis was used to estimate the "effects" of each method of preparation.[2] Each of the five methods of preparation plus all possible pairs of interactions between methods were used as independent variables to predict GMAT scores. Verbal, quantitative and total scores served as the dependent (predicted) variables in separate analyses. It was hypothesized that the effects of some methods of preparation might vary with the ability level of the examinee. Undergraduate grade point average (UGPA) was considered to be one measure of differential academic achievement among examinees in the sample; first-time GMAT score, a measure available from second-time test takers, was considered to be another. In order to adjust the analysis for differences among examinees in the sample, UGPA was used as a covariate when the effects of methods for first-time test takers were analyzed. Both UGPA and first-time scores were used as covariates when the effects of methods for second-time test takers were analyzed.

Finally, sex and U.S. population subgroup were included as dichotomous independent variables. Data on these variables were included in the analyses in order to test the hypotheses that there were no differences between male and female examinees or among examinees from different U.S. population subgroups with respect to the relationship between method of preparation and test performance. It has been suggested in previous research (e.g. Novick, 1982; Messick, 1980) that the use of test preparation methods might differentially benefit members of different subpopulations. If this supposition is true, it would be incorrect to group data from members of the different subpopulations together and perform a single regression analysis. Two-way interactions

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[2] Use of the word "effect" does not imply that the test preparation methods studied in this research "caused" differences in test scores. The word effect is simply a shorthand for the average differences in test score of groups of candidates who differed in their use of test preparation methods but who were "statistically equal" on the other variables included in the particular analysis.

between each of these coded variables and all other variables in the equation were included in order to test whether the effects could be considered simultaneously for all subpopulations, or whether it was necessary to compute separate regressions for males and females or for examinees who were members of different subgroups in order to interpret significant main effects. If the relationships are similar, the coefficients of the interaction terms will not be significantly different from zero.

RESULTS

The results of this study will be presented separately for first-time and second-time test takers. A general description of GMAT test performance, background information and methods of test preparation for first-time test takers will be presented first. This will be followed by the results of the multiple regression analyses based on the data from the first-time test takers. A description of the second-time test-taker sample and the results of the multiple regression analyses based on the data obtained from them will then be presented in the same format.

First-time Examinees

Description of Sample

The sample used in this part of the study consisted of first-time test takers who reported that they were members of one of four U.S. population subgroups: Spanish-American[3], Oriental/Asian, Afro-American/Black or Caucasian/White. Additional subgroups were not included because sample sizes were too small. Eighty-five percent of all first-time test takers were members of the Caucasian/White subgroup. Every twentieth examinee from that subgroup was selected in order to make the subgroup sizes more comparable for the regres-

[3]U.S. citizens of Puerto Rican and Mexican descent were combined for purposes of statistical analyses, based on common language. However, the authors acknowledge cultural diversity between the groups.

sion analyses. Only first-time test takers on whom complete data were available and who were U.S. citizens were included in the regression samples.

Average GMAT verbal, quantitative and total scores were calculated for all 1981-82 examinees in this sample who responded to at least one of the test preparation questions. In order to determine whether the sample of first-time test takers used in this study was representative of all GMAT first-time test takers, these statistics were compared to the corresponding statistics for first-time test takers in 1981-82 who did not respond to any of the questions as well as to all test takers who were U.S. citizens from the 1980-81 and 1979-80 testing years. The results of these comparisons are presented separately for each subgroup in Table 1. As can be seen from Table 1, the score means of the examinees who responded to the questions were higher than the comparable means for non-respondents. The means of the GMAT verbal, quantitative and total scores for the examinees in this sample are slightly higher than the comparable mean scores obtained by all test takers in either of the two testing years. These results were consistent across all four subgroups.

Appendix A shows, separately for each subgroup, the number of examinees responding "yes" and the number responding "no" to each question about test preparation method. These tables also present mean GMAT verbal, quantitative and total scores; mean UGPA; mean age; and average number of months of work experience for examinees who did and did not use each method of preparation.

The number of examinees making use of each method varied considerably. It can be seen by comparing the four tables that the proportion of examinees responding "yes" and "no" to each method of preparation did not vary much across the four subgroups. The most widely used method for each of the subgroups was studying the GMAT Bulletin, with between 71 and 77 percent of the examinees responding that they had done so. The least used method was to attend a test preparation or coaching course, with 7 percent of the Blacks, 6 percent of the Whites, 11 percent of the Oriental Asians and 8 percent of the Spanish-Americans reporting that they had done so.

Overall, mean GMAT scores for examinees who used each method of preparation did not differ greatly from corresponding scores for examinees who

Table 1

U.S. Population Subgroup Comparison of Mean GMAT Scores of First-time Examinees in the Sample With Non-responding First-time Examinees and All 1980-81 and 1979-80 Examinees

	1981-82 Sample		All 1980-81 U.S. Subgroup	All 1979-80 U.S. Subgroup
	Respondents	Non-respondents	Examinees	Examinees
AFRO-AMERICAN/BLACK				
N	4,318	3,215	8,709	8,939
Verbal	21.03	19.31	19.92	19.25
Quantitative	19.28	18.25	18.82	18.49
Total	377.30	357.73	365.64	358.84
CAUCASIAN/WHITE				
N	4,130	1,875	127,569	128,003
Verbal	29.61	28.75	28.98	28.51
Quantitative	28.32	27.29	27.38	27.38
Total	496.87	484.12	487.07	482.76
ORIENTAL/ASIAN				
N	1,948	1,524	3,508	3,408
Verbal	25.98	23.84	25.04	24.44
Quantitative	28.95	27.80	27.68	27.46
Total	472.58	448.90	457.71	450.15
SPANISH-AMERICAN				
N	1,170	777	2,060	1,840
Verbal	24.00	21.87	23.08	22.14
Quantitative	22.92	20.93	22.08	21.81
Total	421.72	393.42	409.87	400.36

reported that they did not use the method. The largest differences can be seen among examinees who differed in their use of an independent study of mathematics. For examinees from each of the subgroups, those who reported that they had pursued their own study of mathematics averaged lower on GMAT verbal, quantitative and total scores than those who had not. Examinees who reported using each of the other four methods tended to attain higher mean verbal and total scores than those who did not. Mean quantitative scores differed slightly and inconsistently between examinees responding "yes" and "no" to the use of each of the other four methods.

Undergraduate grade point averages for examinees who responded "yes" to each of the preparation methods were not different from the UGPAs for examinees who responded "no". Examinees who reported that they had used a book not published by ETS on how to prepare for the GMAT or had attended a test preparation course tended to be slightly younger than those who did not. Those reporting that they had used the other three methods tended to be slightly older than those who did not. Examinees who used a test preparation book not published by ETS and those who attended a course also tended to have had less work experience than those who did not. Work experience is probably not independent of age, so this result is not surprising.

Mean GMAT scores of examinees who chose not to respond to any question were lower than mean scores for examinees who responded "yes" or "no" to any of the questions dealing with preparation methods. Mean UGPA for the non-respondents was lower than for any group of respondents. Finally, non-respondents tended to be older than respondents.

It can be deduced from the number of examinees who reported using each individual method, that many examinees were using more than one method to prepare for the GMAT. The percent of examinees from each subgroup who reported using each possible pair of methods of preparation is reported in Table 2. For some of the pairs, the percent of examinees reporting that they had used both methods was almost as large as the percent using the single method. For example, 18 percent of the Black examinees reported that they worked through an actual GMAT and that they studied the Bulletin. It was

Table 2

Percents of First-time Examinees Using

Multiple Methods of Test Preparation

Method	Method	Afro-American/ Black	Caucasian/ White	Oriental/ Asian	Spanish-American
Studying the Bulletin	Doing an actual GMAT	18%	18%	18%	17%
Studying the Bulletin	Using preparation book	33%	39%	41%	33%
Studying the Bulletin	Attending a course	5%	5%	8%	5%
Studying the Bulletin	Own study of math	32%	22%	23%	27%
Doing an actual GMAT	Using preparation book	9%	8%	10%	8%
Doing an actual GMAT	Attending a course	2%	2%	5%	3%
Doing an actual GMAT	Own study of math	11%	7%	7%	8%
Using preparation book	Attending a course	4%	4%	7%	5%
Using preparation book	Own study of math	22%	19%	22%	21%
Attending a course	Own study of math	4%	3%	4%	4%

reported in Appendix A that 21.4 percent of Black examinees reported that they had worked through an actual GMAT. Thus, most of the examinees who worked through an actual GMAT also studied the Bulletin.

Multiple Regression Analyses

Multiple regression analyses were used to explore the relationships between use of test preparation methods and GMAT score, controlling for prior academic achievement as indicated by UGPA. The data from the 10,017 examinees in the sample, for whom complete data were available, were used in the multiple regression analyses. These data were initially entered into a multiple regression in which the independent variables were:

- o the five methods of preparation (coded "0" for a response of "no" and "1" for a response of "yes"),
- o UGPA,
- o a dichotomous variable (0,1) representing U.S. population subgroup membership,
- o the pairs of interaction terms among the five methods, and
- o the terms for interaction between
  - o subgroup membership and preparation methods,
  - o UGPA and preparation methods, and
  - o sex and preparation methods.

The regression weights of the interactions between subgroup membership and the other independent variables in the equation indicated that the regression of GMAT score on method of test preparation had statistically significantly different effects on scores for the different subgroups. Therefore, regressions were calculated separately for each of the four subgroups for each of the three dependent variables. The complete results of these regression analyses are presented in Appendices B, C, D and E for the Afro-American/Black, Caucasian/White, Oriental/Asian, and Spanish-American subgroups, respectively. A similar test was made for possible differences between males and females. Since the regression weights estimated for the interaction terms between sex and method of test preparation were not significantly different from zero, data for males and females were combined and single regression equations by subgroup were formulated.

Main Effects. Estimates of the effects of each method of preparation and the corresponding standard errors are shown in Table 3 for each of the four subgroups examined. A caution noted by Powers (1981) when examining the effects of methods of test preparation on the SAT should be restated here. The estimates of the effects of the methods of test preparation are, in fact, a combination of both the method selected and of the examinee's decision to use it. Data are not available to separate the effects of these factors, so that we cannot ascertain whether examinees who responded 'yes' to any of the research questions might be more likely to have obtained higher GMAT scores than those who responded 'no' "even without using the particular preparation method, because they differ in some other ways that are related to test scores" (p. 6).

The multiple correlations (Rs) between GMAT scores and the linear combination of independent variables are also presented in Table 3. These correlations differed slightly across subgroups. For each of the GMAT scores (verbal and quantitative are not independent of total score), the multiple correlations were highest for Oriental/Asians and lowest for Blacks. These multiple correlations were only moderate. A large proportion of the variance in GMAT scores is unrelated to UGPA, sex and test preparation. In addition, the simple correlations of UGPA with GMAT scores were .18 (verbal), .11 (quantitative), and .18 (total) for Blacks; .29 (verbal), .18 (quantitative) and .28 (total) for Whites; .32 (verbal), .25 (quantitative) and .33 (total) for Oriental/Asians; and .28 (verbal), .18 (quantitative) and .27 (total) for Spanish-Americans. Thus, a large percent of the variance accounted for in the total regression analysis is attributable to one variable, UGPA.

It can be seen from Table 3 that the effects of the different methods of preparation/self selection varied widely and the effects of the same method of preparation/self selection for the different subgroups varied widely. Since each of the methods of preparation was entered into the multiple regression equation as a zero-one dichotomous variable, the regression weights can be interpreted as the expected difference in GMAT score anticipated from a "yes" response to using that method of preparation when the effects of the other independent variables are held constant.

Table 3

Estimates of Effects (regression weights) and Standard Errors for Each Method of Preparation:

First-time Examinees by Subgroup

Method of Preparation	Afro American/Black		Caucasian/White		Oriental/Asian		Spanish-American	
	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect
Verbal Score								
1. Study the sample questions in the GMAT registration bulletin	1.26315*	0.41880	1.63426*	0.41812	1.44111*	0.69726	0.76684	0.76638
2. Work through an actual GMAT published by ETS	0.53360	0.84468	1.56122	0.90220	2.71226	1.54030	1.92703	1.72227
3. Use a book not published by ETS on how to prepare for the GMAT	3.01756*	0.55737	1.60934*	0.52896	3.24842*	0.77835	2.50899*	1.04289
4. Attend a test preparation or coaching course for the GMAT	1.83927	1.11402	2.76152*	1.08691	3.97552*	1.41876	1.08892	2.07712
5. Undertake on your own any review of mathematics	-1.12250	0.65383	-1.42029	0.76968	-2.17887*	1.08450	-0.96796	1.24060
Multiple Correlation[a]	.266**		.322**		.366**		.353**	
Quantitative Score								
1. Study the sample questions in the GMAT registration bulletin	0.14789	0.33901	1.23039*	0.43139	1.41949*	0.68698	0.60334	0.68538
2. Work through an actual GMAT published by ETS	0.32668	0.68375	0.77377	0.93083	2.52371	1.51759	0.75690	1.54023
3. Use a book not published by ETS on how to prepare for the GMAT	1.56686*	0.45118	1.20600*	0.54575	1.70263*	0.76687	1.62278	0.93266
4. Attend a test preparation or coaching course for the GMAT	1.31587	0.90177	2.16917	1.12141	0.54827	1.39784	1.10816	1.85759
5. Undertake on your own any review of mathematics	-1.15403*	0.52926	-2.87355*	0.79411	-1.90464	1.06851	-1.02522	1.10948
Multiple Correlation[a]	.267**		.331**		.407**		.335**	
Total Score								
1. Study the sample questions in the GMAT registration bulletin	10.67799*	4.68919	19.54058*	5.04963	19.19332*	8.20997	10.25137	8.82428
2. Work through an actual GMAT published by ETS	4.38152	9.45770	16.42691	10.89575	33.93997	18.13651	19.37683	19.83061
3. Use a book not published by ETS on how to prepare for the GMAT	32.44641*	6.24078	19.30030*	6.38823	34.30602*	9.16480	29.80313*	12.00801
4. Attend a test preparation or coaching course for the GMAT	23.14638	12.47338	33.5811*	13.12652	32.19020	16.70542	13.20169	23.91635
5. Undertake on your own any review of mathematics	-15.85016*	7.32081	-28.36822*	9.29538	-28.57801*	12.76960	-13.69139	14.28448
Multiple Correlation[a]	.270**		.332**		.402**		.348**	

*$p < .05$ **$p < .0001$ [a]For variables and full regressions, see Appendices B to E.

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For all GMAT scores across all subgroups, the regression coefficients associated with the independent review of mathematics is negative. It is improbable that reviewing mathematics causes examinees to score more poorly than not reviewing. More likely, the negative effects are a result of the fact that lower ability examinees selected review of mathematics as a method of preparation. The fact that a negative weight for reviewing math was also found when verbal score was used as the dependent variable supports this hypothesis. A similar negative effect was seen in a study of the effect of reviewing mathematics on SAT scores (Powers, 1981). These findings provide a clear example of why it is incorrect to infer cause and effect relationships from these results.

Among both Black and Spanish-American examinees, using a book not published by ETS on how to prepare for the GMAT, with the corresponding self-selection factors, showed the largest differential for verbal, quantitative and total scores. Among White/Caucasian examinees, attending a coaching course/self selection had the largest effect when analyzing each of the three scores. Oriental/Asian examinees evidenced the greatest effects from attending a course/self selection when analyzing verbal scores, from working through an actual GMAT/self selection when analyzing quantitative scores and from using a review book not published by ETS/self selection when analyzing total scores. The relationship between their total scores and working through an actual GMAT/self selection and between their total scores and attending a test preparation or coaching course/self selection were almost equal (i.e., 34 and 32 points, respectively).

The largest differences in effects among subgroups appear to occur in working through an actual GMAT. However, the standard errors associated with these effects are fairly large and only two of the effects are statistically significant ($p<.05$). The greatest "effects" from test preparation methods seem to be experienced by Oriental/Asian examinees. Also, in scaled score terms, the relationship between each of the five methods of preparation/self selection and test performance seemed to be greater when considering GMAT verbal scores than when considering GMAT quantitative scores.

Interaction Effects. The number of examinees responding "yes" to the use of each of the methods of preparation and the data presented in Table 3 showed that many examinees used more than one method. It was hypothesized that the effect of any particular method of preparation might be mediated by the simultaneous or sequential use of other methods. For example, it was not known if the cumulative effect of doing an actual GMAT and also studying the Bulletin would be different from the simple sum of the effects of using each method alone.

Interactions between all possible pairs of the methods of test preparation were entered into the multiple regression equations when verbal, quantitative, and total scores each were used as dependent variables. Interactions which were significant ($p<.05$) differed for the different dependent variables and different subgroups. That is, interactions which had significant relationships were not the same for each score nor were they the same for each of the subgroups. The multiple regression weights for interactions between all pairs of test preparation methods are presented in Table 4. Significant interactions ($p<.05$) are marked with * .

For each interaction between pairs of test preparation methods, examinees can be separated into four mutually exclusive response categories: those who used both methods, those who used neither method, and those who used either one but not the other method. The sign associated with the multiple regression weight indicates whether using both methods of preparation/self selection had a further increased (positive) or decreased (negative) effect on GMAT scores after adjustments for using each of the methods alone had been made.

Inspection of Table 4 reveals that only one significant ($p<.05$) interaction effect (using a test preparation book and doing a review of mathematics for Black examinees) was positive. Interaction effects for each dependent variable will be considered separately. The mean scores for examinees in each of the four possible response categories for each of the significant interaction effects are presented separately for verbal, quantitative and total scores in Appendix F.

Table 4

Interaction Regression Weights for All Preparation Method Pairs:

First-time Examinees by Subgroup

Methods of Preparation		Afro-American/Black		Caucasian/White		Oriental/Asian		Spanish-American	
		Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect
Verbal Score									
Studying the Bulletin	Doing an actual GMAT	-0.31939	0.85407	-1.55530	0.91631	-3.52144*	1.55508	-0.88606	1.77853
Studying the Bulletin	Using preparation book	-1.42582*	0.61707	-0.53445	0.59566	-1.61172	0.91238	0.02480	1.16216
Studying the Bulletin	Attending a course	-0.47655	1.10746	-0.89006	1.12476	0.37866	1.48821	1.57409	1.93448
Studying the Bulletin	Own study of math	-0.41979	0.65859	0.23283	0.72303	0.74817	1.04755	-1.33913	1.27476
Doing an actual GMAT	Using preparation book	0.05460	0.65963	-0.51598	0.63312	1.19852	1.05795	-0.45533	1.29107
Doing an actual GMAT	Attending a course	2.00902	1.09742	1.80391	1.06953	-0.65403	1.40192	1.14878	1.93959
Doing an actual GMAT	Own study of math	-1.23071	0.64612	-0.22680	0.67329	0.78883	1.12771	-0.83859	1.32723
Using preparation book	Attending a course	-0.62399	1.04355	-3.19729*	1.05894	-3.23887*	1.42095	-2.75941	1.93164
Using preparation book	Own study of math	1.10021*	0.53800	0.25541	0.58387	-0.56136	0.95575	0.83181	1.05813
Attending a course	Own study of math	-1.91924	1.03035	1.56307	1.05457	-1.55427	1.38513	-0.03251	1.86745
Quantitative Score									
Studying the Bulletin	Doing an actual GMAT	-0.14276	0.69135	-1.50617	0.94539	-2.65822	1.53215	0.72125	1.59056
Studying the Bulletin	Using preparation book	-0.60987	0.49951	-0.34042	0.61457	-0.86608	0.89892	-0.84539	1.03933
Studying the Bulletin	Attending a course	-0.00581	0.89647	-2.19544	1.16046	1.03336	1.46629	-0.51133	1.73002
Studying the Bulletin	Own study of math	-0.21011	0.53311	0.84111	0.74597	-1.62973	1.03210	-0.19751	1.14003
Doing an actual GMAT	Using preparation book	0.38244	0.53395	-0.89689	0.65322	-0.08857	1.04235	-0.09338	1.15462
Doing an actual GMAT	Attending a course	1.10477	0.88834	1.88160	1.10348	1.00281	1.38125	1.83215	1.73459
Doing an actual GMAT	Own study of math	-1.08454*	0.52302	0.86924	0.69466	0.36940	1.11108	-2.55261*	1.18695
Using preparation book	Attending a course	-2.55796*	0.84473	-1.01880	1.09254	-1.29729	1.40000	0.40045	1.72748
Using preparation book	Own study of math	0.55382	0.43549	-0.07905	0.60240	0.20440	0.94166	0.15260	0.94630
Attending a course	Own study of math	-0.29421	0.83405	0.23971	1.08804	-0.88286	1.36470	-3.22185	1.67008
Total Score									
Studying the Bulletin	Doing an actual GMAT	-2.44571	9.56276	-20.39623	11.06616	-41.41034*	18.31049	-1.53496	20.47833
Studying the Bulletin	Using preparation book	-15.09605*	6.90921	-6.05852	7.19376	-17.27765	10.74294	-5.13085	13.38129
Studying the Bulletin	Attending a course	-3.82264	12.39999	-20.01995	13.58361	8.18561	17.52316	9.12349	22.27396
Studying the Bulletin	Own study of math	-4.05278	7.37405	6.45723	8.73193	-3.68064	12.33455	-12.47829	14.67785
Doing an actual GMAT	Using preparation book	3.37200	7.38566	-9.55130	7.64616	7.99806	12.45697	-5.11052	14.86568
Doing an actual GMAT	Attending a course	21.74186	12.28756	24.51315	12.91664	3.33177	16.50717	20.91367	22.33279
Doing an actual GMAT	Own study of math	-15.40522*	7.23444	3.38544	8.13121	9.54443	13.27836	-21.78415	15.28196
Using preparation book	Attending a course	-19.82898	11.68439	-30.20090*	12.78866	-31.23408	16.73124	-19.36128	22.24124
Using preparation book	Own study of math	11.89275*	6.02379	2.41771	7.05136	-2.24646	11.25362	7.76305	12.18357
Attending a course	Own study of math	-17.04826	11.53659	14.22651	12.73593	-18.12824	16.30942	-18.35629	21.50224

* $p < .05$

No significant interaction effects on verbal scores were found among Spanish-American examinees. The interaction between studying the Bulletin and doing an actual GMAT was significant for Oriental/Asian examinees but not for any others. The associated regression weight was negative.

In order to interpret the negative weight assigned to this interaction, the weights assigned to each of the methods alone must also be considered. The effect on GMAT verbal score for Oriental/Asian examinees of studying the Bulletin was 1.44 points and the effect of doing a GMAT was 2.71 points, resulting in an expected total effect of 4.15 verbal score points for using both preparation methods. But these two effects were not simply additive. The weight associated with the interaction effect resulted in subtracting 3.24 points from the cumulative effect (i.e., the negative sign). The total effect from preparing by both studying the Bulletin and doing an actual GMAT was only .9 of a score point. A possible explanation is that lower ability examinees feel the need to employ both methods of preparation.

A significant interaction between studying the Bulletin and using another test preparation book was found among Black examinees. This effect was also negative. Significant interactions were found between using another test preparation book and attending a coaching course among Oriental/Asian and Caucasian examinees (negative effects) and between using another test preparation book and pursuing their own study of mathematics among Black examinees (positive effect). No other pairs of methods of test preparation had a significant effect on GMAT verbal scores for any of the subgroups studied. GMAT verbal score means, standard deviations and frequencies for examinees in each of the response categories (yes, yes; no, no; yes, no; no,yes) for each of the significant interactions are presented in Appendix F. Each cell in the table represents a response category and contains a mean GMAT verbal score, the number of examinees who made that response and the standard deviation of the verbal scores for those examinees, respectively.

For this sample, the mean verbal score for Oriental/Asian examinees who did an actual GMAT and did not study the Bulletin is 2.5 points higher than the mean verbal score of all examinees in that subgroup. The mean score for examinees in each of the other categories is approximately equal to the

overall mean. It should also be noted that only 34 examinees are included in that response category.

For each of the five significant test preparation method interactions, the mean verbal scores for examinees who reported that they did use one of the methods, but did not use the other, was higher than the mean verbal scores for examinees who reported that they used both methods. For example, the mean score of Oriental/Asian examinees who did an actual GMAT, but who did not study the GMAT Bulletin was approximately 2.5 points higher than the mean score for examinees who did both. Similarly, the mean score for Black examinees who used a test preparation book, but did not study the Bulletin, was a little more than half a point higher than for examinees who did both; and the mean score for Blacks who used a test preparation book, but did no additional review of mathematics, was almost a point higher than those who did both. For both Caucasian and Oriental/Asian examinees, the means for those who took a course, but did not use an additional test preparation book, was approximately two points higher than those who did both.

It is also interesting to note that for four of the significant interactions on verbal score, the lowest mean score was associated with those examinees who reported that they did not use either method to prepare for the examination. The exception was the "using other book" by "own study of mathematics" interaction for Black examinees. The lowest mean was associated with examinees who only reviewed mathematics on their own. This is consistent with the negative regression weight determined for this method when it was used alone and the hypothesis pertaining to the negative effects discussed previously. Even for this interaction, the mean for examinees who reported that they had not used either method was the second lowest and was lower than the overall mean for Black examinees.

These data substantiate the importance of the factor of examinee selection in evaluating the effects of test preparation methods. In other words, it seems that lower scoring examinees are more likely to use more than one method of preparing for the examination than higher scoring examinees. However, it also seems that examinees who use some method of preparation tend to score higher than those who do not. It is not clear whether this is a result of the

method of preparation chosen, of characteristics of the examinees choosing to use the methods, or (more probably) some combination of the two.

Three interactions were significant ($p<.05$) when GMAT quantitative score was used as the dependent variable. The interaction between doing an actual GMAT and undertaking additional study of mathematics was significant for Black and Spanish-American examinees and the interaction between using a test preparation book and taking a coaching course was significant for Black examinees. Again, all interaction regression weights were negative, thus showing the diminished effects of each method for examinees choosing to use both methods.

The same pattern seen for interactions when examining verbal means was also found among quantitative mean scores. That is, the mean scores for examinees responding "yes" to using one of the methods but "no" to using the other is higher than the mean scores for examinees reporting that they used both methods and also higher than the mean scores for examinees reporting that they used neither method. Again, these data seem to suggest that selection by examinees is an important factor in the ultimate relationships of method of preparation to test score.

Five interaction effects were significant ($p<.05$) when GMAT total score was used as the dependent variable in the regression equations. These included the interactions between studying the Bulletin and working through an actual GMAT for Oriental/Asian examinees; between studying the Bulletin and using another test preparation book, working through a GMAT and studying mathematics, and using a test preparation book and studying mathematics for Black examinees; and between using a test preparation book and taking a course for Caucasian examinees. As seen previously in Table 4, the effects of four of the five interactions were negative.

Inspection of the mean total GMAT scores for examinees in each of the response categories for the significant interaction effects suggests that these results are consistent with the results for verbal and quantitative scores discussed previously. That is, the mean scores for examinees using only one of the preparation methods tended to be higher than the mean scores for examinees using neither or both.

Second-time Examinees

Description of Sample

There were 8,636 examinees who took the GMAT for the second time during the 1981-82 testing year, who were U.S. citizens and who responded to the method of test preparation questions for their second testing. Average GMAT verbal, quantitative and total first- and second-time scores for these examinees are presented in Table 5. First- and second-time mean GMAT scores are also reported for 1981-82 second-time test takers who did not respond to the research questions for their second testing, as well as for all 1981-82 and all 1980-81 second-time test takers. It can be seen from Table 5 that the examinees who responded to the questions obtained mean GMAT scores that were higher than the mean scores obtained by those who did not respond as well as higher than all second-time test takers in 1981-82 and in the previous testing year.

Table 5

Comparison of Second-time Examinee Sample Score Means with Score Means of Non-responding Second-time Examinees and of All 1981-82 and 1980-81 Second-time Examinees

	1981-82 Sample[a]		All 1981-82	All 1980-81
	Respondents	Non-respondents	Examinees[b]	Examinees[b]
Number	8,638	1,409	22,281	22,359
Current Verbal	27.1	22.6	24.8	25.0
Current Quant	26.1	22.7	26.1	25.8
Current Total	464.8	408.8	446.9	446.5
First Verbal	24.3	20.2	22.3	22.4
First Quant	23.9	20.9	24.0	24.0
First Total	430.1	380.7	414.9	415.4

[a]Only U.S. citizens

[b]Includes non-U.S. citizens

Appendix G shows the number of second-time examinees who used each method of preparation for their second examination, the associated first- and second-time mean GMAT verbal, quantitative and total scores, mean UGPA, mean age in 1982 and the average amount of work experience (reported in months). As was the case with first-time test takers, the number of examinees making use of each method varied considerably. Studying the GMAT Bulletin was again the most widely used method, with 68% of the examinees reporting that they had done so. Using a test preparation book not prepared by ETS was also used by second-time test takers, with 61% of the examinees reporting that they had done so.

Attending a test preparation or coaching course was still the least used method. Seventeen percent of second-time test takers reported that they took such a course. This is considerably larger than the six to eleven percent of first-time test takers who attended a test preparation course and is probably at least partially attributable to the self selection involved in being a second-time test taker.

As was the case among first-time test takers, the mean GMAT scores for examinees who used or did not use each method of preparation did not differ greatly. The largest difference in second GMAT scores occurred between examinees who chose to use a review book not prepared by ETS and those who did not choose to use such a book. It should be noted, however, that the largest difference on first scores was seen between the same two groups (i.e., those who did or did not use a review book). Finally, the amount of gain experienced by examinees who reported using that method was similar to the gain by examinees who did not use it.

Examinees who pursued additional study of math averaged lower second quantitative and total scores than those who did not. This is the same pattern that was seen among first-time examinees. Again, the most probable explanation is selection rather than causation. That is, examinees who were less able mathematically were more likely to have chosen this method. Some confirmation of this hypothesis is found in examining first-time scores for these examinees. First-time mean quantitative and total scores for examinees who reported that they had reviewed math were lower than the mean scores for

examinees who did not and also were lower than mean scores for examinees who reported using any other method.

The largest difference in gain scores between examinees reporting that they had or had not used each method of preparation occurred between those who had or had not attended a coaching course (3.94 and 2.59 scaled score points verbal gain; 2.93 and 2.05 scaled score points quantitative gain; 47.58 and 32.15 scaled score points total gain, respectively). Those examinees who reported that they had attended a course achieved a larger mean gain in each GMAT score than examinees reporting that they had used any other method of preparation. However, additional facts must be considered in interpreting these score gains. First, only 17% of the second-time examinees took a course. The characteristics of these examinees which determined their selection of this method of preparation and the effect of those characteristics on test performance are confounded with the effects of the coaching course. We can tell from the table that the mean first scores and mean UGPAs for examinees who attended a course were similar to the corresponding first scores and UGPAs for those who did not.

It should also be noted that the standard deviations of the gain scores were larger than the means. This indicates that there is substantial variation in the amount of score change achieved by individual examinees, with many examinees obtaining lower scores the second time.

Paralleling the results found among first-time examinees, undergraduate grade point averages were almost identical between examinees who used each method of preparation and those who did not. Also in parallel with the first-time sample, non-respondents to the methods of preparation questions reported lower UGPAs than respondents.

It was apparent that many of the examinees in this sample had used more than one method of preparation. The number and percent of examinees who reported that they had used each pair of methods are reported in Table 6. It can be seen from the table that a higher percent of second-time examinees reported using each pair of methods than was reported by first-time examinees. However, the relative positions, in terms of frequency of reporting pairs,

Table 6

Percents of Second-time Examinees
Using Multiple Methods of Test Preparation

Method	Method	%
Studying the Bulletin	Doing an actual GMAT	25
Studying the Bulletin	Using preparation book	43
Studying the Bulletin	Attending a course	10
Studying the Bulletin	Own study of math	32
Doing an actual GMAT	Using preparation book	17
Doing an actual GMAT	Attending a course	7
Doing an actual GMAT	Own study of math	15
Using preparation book	Attending a course	11
Using preparation book	Own study of math	31
Attending a course	Own study of math	9
Total Second-time Examinees in Sample		8,636

remained unchanged. The highest proportion reported that they had both studied the Bulletin and used a test preparation book and the smallest proportion reported that they had both done an actual GMAT and taken a course.

Multiple Regression Analyses

Multiple regression analyses were used to determine the effects of the five methods of test preparation on the most recent GMAT verbal, quantitative and total scores of second-time test takers, independent of ability as measured by UGPA and first scores on the GMAT. The data from the 8,636 second-time test takers were initially entered into a multiple regression equation in which the independent variables were the five methods of preparation (coded "0" for a response of "no" and "1" for a response of "yes"), UGPA, first-time GMAT score, sex, a coded variable representing U.S. population subgroup membership, and all possible pairs of interactions among the five methods. There were no significant interactions between subgroup membership and the other independent variables in the equation or between sex and the other

independent variables in the equation. As a result, the data from all second-time test takers were combined and were analyzed using a single regression equation for each dependent variable. The complete results of the regression analyses on GMAT verbal, quantitative and total scores for second-time examinees are presented in Appendix H.

Main Effects. Estimates of the effects of each method of preparation/self selection and the corresponding standard errors, for each of the three GMAT scores, are shown in Table 7. The multiple correlation (R) between the independent variables in the equations for the second-timers and each GMAT score are also presented in Table 7. The Rs are much higher than those obtained from regressions using first-time test taker data. However, the regression equations for second-time examinees also included first-time score as an independent variable. These first scores accounted for much of the variance in second scores. The simple correlations between first and second GMAT scores for second-time examinees are .75 for verbal, .78 for quantitative and .84 for total scores. It can be seen from Table 7 that the regression weights associated with the different methods of preparation varied widely.

The weights can be interpreted in the same manner as the weights obtained for first-time examinees (explained previously). It will be noted that the sizes of the regression weights associated with each method of preparation and the accompanying self-selection factors are much smaller for second-time than for first-time examinees. This is largely a consequence of the inclusion of first-time GMAT score as an independent variable.

When verbal, quantitative and total second scores were regressed on the predictor variables, the largest effects were associated with using a test preparation book and with attending a test preparation course. These were the only methods that were significant ($p<.05$) when each of the GMAT scores was regressed on the independent variables.

Interaction Effects. Interaction effects between every possible pair of test preparation methods were also entered into the regression equations for second-time test takers. The effects for the interactions between all possible pairs of test preparation methods and the corresponding standard errors of

Table 7

Estimates of Effects (regression weights) and Standard Errors for Each Method of Preparation: Second-time Examinees

Method of Preparation	Verbal Score		Quantitative Score		Total Score	
	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect
1. Study the sample questions in the GMAT registration bulletin	-0.06043	0.21000	-0.00253	0.18729	-0.82579	2.04245
2. Work through an actual GMAT published by ETS	0.46078	0.29506	0.06466	0.26308	4.01518	2.86919
3. Use a book not published by ETS on how to prepare for the GMAT	0.92468*	0.21571	0.43828*	0.19242	8.68991*	2.09843
4. Attend a test preparation or coaching course for the GMAT	1.89694*	0.30540	1.26913*	0.27235	22.00002*	2.97002
5. Undertake on your own any review of mathematics	-0.27753	0.28264	0.08903	0.25215	-1.81324	2.74817
Multiple Correlation (for variables and full regression, see Appendix H)	.763		.795		.845	

* $p < .05$

the effects are presented in Table 8. Statistically significant interactions ($p<.05$) are marked with * .

The interactions between studying the Bulletin and undertaking one's own review of mathematics and between studying a test preparation book and taking a test preparation course were found to be significant ($p<.05$) when GMAT verbal score was used as the dependent variable. The same two interactions were significant when total score was used as the dependent variable. Taking a test preparation course paired with reviewing math independently, doing an actual GMAT, and studying a test preparation book, respectively, all resulted in significant interactions ($p<.05$) when GMAT quantitative score was used as the dependent variable.

GMAT verbal, quantitative and total score means, standard deviations and frequencies for examinees in each response category (yes, yes; no, no; yes, no; no, yes) for each of the significant interactions are presented separately in Appendix I. For both pairs of test preparation methods that resulted in significant interactions when verbal score was used as the dependent variable, the lowest mean scores were earned by examinees who chose to use neither method. However, the highest score was earned by examinees who chose to use one but not the other method. That is, examinees who attended a course but did not use other review material earned, on the average, higher GMAT verbal scores than examinees who used a test preparation book but did not attend a course and earned higher scores than examinees who both attended a course and used a test preparation book. In the same way, examinees who practiced by doing an actual GMAT but who did not do any additional study of mathematics on their own earned higher mean GMAT scores than examinees who studied mathematics on their own but did not do an actual GMAT. They also earned higher scores than examinees who both studied mathematics on their own and did an actual GMAT.

As was the case with GMAT verbal scores, examinees who reported that they had neither attended a test preparation course nor used another GMAT test preparation book earned lower mean quantitative scores than examinees who responded "yes" to having used either or both of the methods. Examinees who

Table 8

Interaction Regression Weights for All Preparation Method Pairs:

Second-time Examinees

Methods of Preparation		Verbal		Quantitative		Total	
		Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect	Sample Regression Coefficient	Standard Error of Effect
Studying the Bulletin	Doing an actual GMAT	0.29810	0.29342	0.25989	0.26168	4.48095	2.85363
Studying the Bulletin	Using preparation book	-0.27919	0.24850	-0.17816	0.22161	-3.57657	2.41667
Studying the Bulletin	Attending a course	-0.09737	0.31727	0.00222	0.28289	-1.99063	3.08508
Studying the Bulletin	Own study of math	0.31631	0.25596	0.05295	0.22820	3.76539	2.48929
Doing an actual GMAT	Using preparation book	0.18854	0.25062	0.04218	0.22350	0.78950	2.43754
Doing an actual GMAT	Attending a course	0.28626	0.30977	0.68258*	0.27633	5.61820	3.01303
Doing an actual GMAT	Own study of math	-0.93623*	0.24910	0.00392	0.22217	-7.08800*	2.42253
Using preparation book	Attending a course	-0.97531*	0.31528	-0.80177*	0.28113	-10.91818*	3.06641
Using preparation book	Own study of math	0.03005	0.24136	0.06022	0.21523	0.34341	2.34723
Attending a course	Own study of math	-0.01990	0.30649	-0.67157*	0.27329	-2.82978	2.98054

* $p < .05$

reported using both methods earned lower mean scores than examinees using either method without the other.

Examination of the interaction between doing an actual GMAT and attending a test preparation course suggests that the highest mean quantitative scores were earned by examinees who reported that they used both methods but the lowest scores were recorded for examinees who attended a course but did not do an actual GMAT. This finding further supports the supposition of self-selection bias, that is, it is more unlikely that lower ability examinees chose to take the course than that taking a course caused examinees who did not practice on an actual GMAT to score lower than examinees who did not take the course.

Finally, it was found that examinees who chose to undertake their own study of mathematics scored lower than those who did not choose to do so, irrespective of their decision to attend or not attend a test preparation course.

Again consistent with and not independent of the findings for verbal and quantitative score means, examinees who did not use a test preparation book or attend a preparation course earned the lowest total mean score among examinees in all possible response patterns. Examinees who attended a course but did not use additional review books earned higher mean scores than those who did both or who only used a preparation book.

Those who chose to pursue their own study of mathematics earned lower GMAT total scores irrespective of their decision to practice by doing an actual GMAT. These results follow the same self-selection performance pattern that was found throughout the study.

These data describing interaction pairs are consistent with the data presented earlier in this report that suggested the importance of examinee selection in evaluating the effects of test preparation methods. In other words, the mean scores earned by examinees who chose to use multiple methods of test preparation were not necessarily higher than corresponding means for examinees who chose to use one or the other or neither method.

SUMMARY AND CONCLUSIONS

This study sought to examine the relationship between five methods of test preparation and test performance as measured by GMAT verbal, quantitative and total scores. The study utilized nonexperimental data. That is, the data were obtained from approximately 60% of the 1981-82 GMAT examinees who were U.S. citizens and who voluntarily responded to a questionnaire regarding the methods they had used to prepare for the test. As a result of the manner in which the data were gathered, the effects of the methods themselves were confounded with variables related to examinees' selection of any of the methods of test preparation. This factor prevents the conclusion of a cause and effect relationship between method of preparation and test performance. However, both demographic and performance profiles for examinees who used the various methods and combinations of methods were established.

This study found that the regressions relating method of preparation to GMAT score for first-time test takers were different for examinees who were members of different U.S. population subgroups. Therefore, regressions were computed separately for examinees who were members of the Afro-American/Black, Caucasion/White, Oriental/Asian and Spanish-American subgroups. The rank order of the frequency of using each method was consistent across the subgroups. The largest proportion of first-time examinees reported that they had reviewed the Bulletin followed in descending order by using a test preparation book not prepared by ETS, undertaking their own study of mathematics, working through an actual GMAT, and attending a test preparation course. However, the percents electing to use each method varied across subgroups. Although attending a preparation course was the least frequently used method for all four groups, the smallest percent of attendance was reported by Caucasian/White examinees (6%) followed by Afro-American/Black (7%), Spanish-American (8%) and Oriental/Asian (11%). Consistency of rank ordering for first-time examinees using multiple methods of preparation was also found, with variation in actual percents across subgroups.

It has been suggested that methods of test preparation, particularly participation in a coaching course, are more widely used by majority subgroup

member examinees than by minority members. This is purported to result from such factors as motivation, family support, and financial feasibility and has been suggested to result in an unfair advantage for some examinees (Novick, 1982). However, this study found that similar and frequently higher percentages of minority member examinees used the methods of test preparation when compared with examinees from the Caucasian/White subgroup. The study also found that examinees from each of the subgroups electing to use the various methods of preparation did not differ appreciably in ability as measured by undergraduate grade point average, but did vary slightly in age and amount of work experience.

Results of the multiple regression analyses on first-time examinees differed across the four subgroups. The multiple R's were largest for Oriental/Asian examinees and smallest for Afro-American/Black examinees. The size of the effects associated with each method of preparation, as well as the corresponding standard errors, varied across the four subgroups. The same was true for the interaction effects between pairs of methods. The negative effects associated with examinees' own review of mathematics probably provided the strongest evidence of the confounding between self selection and method of preparation.

Separate analyses were computed for examinees who were taking the GMAT for the second time. In addition to the data that were available describing first-time examinees, first-time GMAT scores were also available for second-time examinees. The mean GMAT scores between second-time examinees who did and did not use each method of preparation did not differ dramatically. Additionally, the magnitude of gain over the first administration score was very similar between examinees who used and did not use each method.

GMAT first scores were entered into the multiple regression analyses of data from second-time examinees as a control for examinee difference in the ability measured by those scores. The sizes of the effects associated with each method of preparation for second-time examinees were considerably less than those obtained using data from first-time examinees. This result is attributed to having controlled for differences in examinee ability measured by first scores. In other words, most of the variance in second scores was

accounted for by the variance in the first scores. When differences in ability were held constant statistically, the effect of using each of the methods of preparation was small. In fact, only the effects of using a test preparation book and of attending a test preparation course were significantly different from zero.

This study has indicated that differences in GMAT scores do exist among examinees using different methods of preparing for the examination. However, the effects of using these methods are confounded with the characteristics of examinees who choose to use each method. One important characteristic is initial ability of the examinee. It was shown that when initial ability, as measured by GMAT first score, was controlled, the sizes of the effects of studying the GMAT Bulletin, working through an actual GMAT, and reviewing mathematics were not significantly different from zero. The effects of using a review book or taking a review course were significant (ranging between .4 and 1.9 points on verbal and quantitative scores).

The effects of the methods on GMAT scores of first-time examinees, for whom a previous score was not available to use as a covariate, were larger. In those analyses (in which self-reported UGPA was used as a less effective control on academic performance), the largest effects associated with any method over the other were about 4, 3 and 33 verbal, quantitative and total score points, respectively. The effects resulted from a combination of self selection and preparation.

There do appear to be relationships between methods of preparation and test scores. However, it must be emphasized that it does not necessarily follow that using any of the methods of preparation causes an increase in scores. Any effect on test performance that resulted from using a particular method of preparation could not be separated from the effect of the individual characteristics of examinees who selected the method.

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APPENDICES

Appendix A

Number of First-time Examinees Responding 'Yes' and 'No' with Verbal, Quantitative and Total Score Means and Mean GPA, Age and Work Experience: Afro-American/Black

MEAN STD DEV	Verbal Score		Quantitative Score		Total Score		Number of Examinees	
	No	Yes	No	Yes	No	Yes	No	Yes
Q. 1 Study Bulletin	20.76 8.06	21.13 7.97	19.51 6.73	19.19 6.37	376.61 92.28	377.55 88.90	1125 26.1%	3193 73.9%
Q. 2 Do Actual GMAT	21.11 7.94	20.74 8.17	19.36 6.46	18.96 6.50	378.50 88.98	372.92 92.59	3392 78.6%	926 21.4%
Q. 3 Use Other Book	20.11 7.81	22.25 8.07	18.91 6.37	19.76 6.56	368.12 87.67	389.42 91.11	2456 56.9%	1862 43.1%
Q. 4 Attend Course	20.97 7.97	21.88 8.18	19.29 6.50	19.05 5.96	376.85 89.95	383.26 87.51	4011 92.9%	307 7.1%
Q. 5 Own Study of Math	21.33 7.94	20.58 8.05	19.76 6.84	18.55 5.79	382.45 91.69	369.49 86.25	2603 60.3%	1715 39.7%
Non- Respondents	19.31 7.85		18.25 6.04		357.73 86.64		3215 42.7%(Total Group)	
	Undergraduate G.P.A.		Age in 1982		Mos. Work Experience			
Q. 1 Study Bulletin N of Examinees	2.843 0.424 977	2.876 0.416 2728	27.05 5.47 1113	27.51 5.94 3174	41.13 37.05 1045	43.11 36.98 3013		
Q. 2 Do Actual GMAT N of Examinees	2.870 0.418 2924	2.858 0.421 781	27.31 5.75 3366	27.69 6.10 921	42.04 37.05 3186	44.66 36.77 872		
Q. 3 Use Other Book N of Examinees	2.860 0.420 2121	2.877 0.417 1584	27.62 6.05 2439	27.09 5.50 1848	43.48 37.66 2304	41.44 36.10 1754		
Q. 4 Attend Course N of Examinees	2.868 0.420 3452	2.853 0.399 253	27.44 5.87 3980	26.80 5.14 307	42.69 36.97 3773	41.39 37.47 285		
Q. 5 Own Study of Math N of Examinees	2.869 0.421 2244	2.864 0.415 1461	27.32 5.81 2585	27.50 5.85 1702	41.79 37.29 2438	43.82 36.55 1620		
Non- Respondents N of Examinees	2.834 0.414 2662		28.75 6.30 3205		44.15 37.14 3035			

Appendix A (continued)

Number of First-time Examinees Responding 'Yes' and 'No' with Verbal, Quantitative and Total Score Means and Mean GPA, Age and Work Experience: Caucasian/White

MEAN STD DEV	Verbal Score		Quantitative Score		Total Score		Number of Examinees	
	No	Yes	No	Yes	No	Yes	No	Yes
Q. 1 Study Bulletin	28.84 7.65	29.84 7.54	27.97 7.74	28.43 7.80	489.07 92.61	499.25 91.11	965 23.4%	3165 76.6%
Q. 2 Do Actual GMAT	29.50 7.50	30.01 7.86	28.43 7.75	27.92 7.91	496.67 90.70	497.61 94.71	3256 78.8%	874 21.2%
Q. 3 Use Other Book	29.17 7.67	30.06 7.47	28.24 7.87	28.40 7.70	493.05 92.68	500.81 90.23	2095 50.7%	2035 49.3%
Q. 4 Attend Course	29.52 7.58	30.91 7.53	28.31 7.79	28.45 7.68	496.13 91.77	507.50 87.87	3862 93.5%	268 6.5%
Q. 5 Own Study of Math	29.73 7.62	29.30 7.48	28.86 7.99	26.87 7.02	501.00 93.20	485.87 86.08	3004 72.7%	1126 27.3%
Non- Respondents	28.75 7.56		27.29 7.87		484.12 92.09		1875 31.2%(Total Group)	
	Undergraduate G.P.A.		Age in 1982		Mos. Work Experience			
Q. 1 Study Bulletin N of Examinees	3.114 0.425 853	3.110 0.433 2794	26.44 4.92 964	27.58 6.16 3159	37.70 33.95 891	43.01 35.91 2988		
Q. 2 Do Actual GMAT N of Examinees	3.106 0.432 2877	3.128 0.429 770	27.30 5.88 3250	27.35 6.04 873	41.93 35.67 3051	41.26 35.04 828		
Q. 3 Use Other Book N of Examinees	3.107 0.440 1857	3.115 0.422 1790	27.42 6.07 2092	27.21 5.74 2031	42.49 36.13 1970	41.07 34.90 1909		
Q. 4 Attend Course N of Examinees	3.107 0.433 3414	3.163 0.396 233	27.39 5.94 3856	26.15 5.38 267	42.26 35.68 3629	34.88 32.59 250		
Q. 5 Own Study of Math N of Examinees	3.111 0.438 2664	3.112 0.414 983	27.18 5.94 3001	27.67 5.84 1122	41.20 35.61 2815	43.34 35.29 1064		
Non- Respondents N of Examinees	3.085 0.430 1605		28.69 6.12 1873		42.42 36.58 1776			

Appendix A (continued)

Number of First-time Examinees Responding 'Yes' and 'No' with Verbal, Quantitative and Total Score Means and Mean GPA, Age and Work Experience: Oriental/Asian

MEAN STD DEV	Verbal Score		Quantitative Score		Total Score		Number of Examinees	
	No	Yes	No	Yes	No	Yes	No	Yes
Q. 1 Study Bulletin	25.92 8.67	26.00 8.49	28.93 8.54	28.96 8.42	472.11 101.71	472.76 101.64	551 28.3%	1397 71.7%
Q. 2 Do Actual GMAT	25.89 8.36	26.34 9.23	28.88 8.26	29.24 9.19	471.53 98.36	476.77 113.80	1558 80.0%	390 20.0%
Q. 3 Use Other Book	24.97 8.50	26.75 8.50	28.80 8.31	29.07 8.56	464.06 100.51	479.15 102.05	848 43.5%	1100 56.5%
Q. 4 Attend Course	25.87 8.48	26.84 9.01	28.98 8.35	28.75 9.22	472.00 100.11	477.22 113.25	1732 88.9%	216 11.1%
Q. 5 Own Study of Math	26.51 8.51	24.77 8.50	30.03 8.47	26.50 7.89	483.01 101.21	448.96 98.67	1351 69.4%	597 30.6%
Non- Respondents	23.84 9.34		27.80 8.44		448.90 107.13		1524 43.9%(Total Group)	
	Undergraduate G.P.A.		Age in 1982		Mos. Work Experience			
Q. 1 Study Bulletin N of Examinees	3.143 0.403 474	3.112 0.432 1161	26.26 5.66 548	26.99 5.71 1394	32.52 33.38 499	35.97 34.86 1292		
Q. 2 Do Actual GMAT N of Examinees	3.124 0.427 1308	3.109 0.411 327	26.75 5.70 1553	26.92 5.74 389	34.85 34.29 1432	35.64 35.30 359		
Q. 3 Use Other Book N of Examinees	3.118 0.430 1455	3.140 0.369 180	27.28 6.13 846	26.40 5.32 1096	37.79 35.75 780	32.86 33.33 1011		
Q. 4 Attend Course N of Examinees	3.089 0.434 714	3.146 0.414 921	26.92 5.72 1727	25.71 5.47 215	36.06 34.89 1591	26.64 29.85 200		
Q. 5 Own Study of Math N of Examinees	3.126 0.420 1150	3.108 0.431 485	26.61 5.58 1348	27.19 5.96 594	34.18 34.32 1250	36.91 34.82 541		
Non- Respondents N of Examinees	3.076 0.428 1210		28.93 6.77 1519		39.14 35.82 1418			

Appendix A (continued)

Number of First-time Examinees Responding 'Yes' and 'No' with Verbal, Quantitative and Total Score Means and Mean GPA, Age and Work Experience: Spanish-American

MEAN STD DEV	Verbal Score		Quantitative Score		Total Score		Number of Examinees	
	No	Yes	No	Yes	No	Yes	No	Yes
Q. 1 Study Bulletin	23.54 7.88	24.19 8.13	22.65 6.90	23.03 7.31	416.31 89.55	423.90 94.76	336 28.7%	834 71.3%
Q. 2 Do Actual GMAT	23.85 7.96	24.65 8.47	22.85 7.06	23.23 7.76	420.03 91.86	428.92 99.19	948 81.0%	222 19.0%
Q. 3 Use Other Book	23.06 8.20	25.25 7.70	22.63 7.24	23.31 7.13	412.63 94.79	433.80 90.00	668 57.1%	502 42.9%
Q. 4 Attend Course	23.92 8.14	24.97 7.02	22.92 7.19	22.92 7.33	421.13 94.13	428.32 83.69	1075 91.9%	95 8.1%
Q. 5 Own Study of Math	24.39 8.20	23.24 7.74	23.63 7.45	21.54 6.46	429.06 95.85	407.37 86.48	774 66.2%	396 33.8%
Non- Respondents	21.87 8.47		20.93 7.18		393.42 96.98		777 39.8%(Total Group)	
	Undergraduate G.P.A.		Age in 1982		Mos. Work Experience			
Q. 1 Study Bulletin N of Examinees	2.994 0.402 288	3.015 0.420 742	26.46 4.72 335	27.65 6.11 834	40.32 34.33 309	43.59 37.22 776		
Q. 2 Do Actual GMAT N of Examinees	3.010 0.417 831	3.009 0.407 199	27.15 5.67 947	27.96 6.14 222	41.72 36.44 877	46.62 36.22 208		
Q. 3 Use Other Book N of Examinees	3.009 0.415 579	3.010 0.415 451	27.38 5.44 667	27.21 6.17 502	44.64 37.11 621	40.01 35.37 464		
Q. 4 Attend Course N of Examinees	3.016 0.416 946	2.935 0.390 84	27.33 5.75 1074	27.02 5.94 95	42.75 36.51 1000	41.64 35.71 85		
Q. 5 Own Study of Math N of Examinees	3.005 0.416 674	3.019 0.413 356	27.41 5.71 774	27.10 5.88 395	43.92 37.20 713	40.25 34.84 372		
Non- Respondents N of Examinees	2.953 0.425 661		29.14 6.65 773		46.10 37.08 729			

Appendix B

Regression Results for First-time Afro-American/Black Examinees

Verbal Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	1.26315	0.41880	0.44205	2.08425	0.07061	3.016	0.0026	Q1 BV
2.Do real GMAT	0.53360	0.84468	-1.12249	2.18969	0.02761	0.632	0.5276	
3.Non ETS book	3.01756	0.55737	1.92477	4.11035	0.18939	5.414	0.0000	Q3 BV
4.Attnd course	1.83927	1.11402	-0.34488	4.02343	0.05886	1.651	0.0988	
5.Math review	-1.12250	0.65383	-2.40441	0.15941	-0.06960	-1.717	0.0861	
Question Interactions								
I12	-0.31839	0.85407	-1.99288	1.35609	-0.01553	-0.373	0.7093	
I13	-1.42582	0.61707	-2.63566	-0.21598	-0.08492	-2.311	0.0209	I13 BV
I14	-0.47655	1.10746	-2.64785	1.69476	-0.01269	-0.430	0.6670	
I15	-0.41979	0.65859	-1.71103	0.87144	-0.02493	-0.637	0.5239	
I23	0.05460	0.65963	-1.23867	1.34787	0.00194	0.083	0.9340	
I24	2.00902	1.09742	-0.14260	4.16063	0.03772	1.831	0.0672	
I25	-1.23071	0.64612	-2.49750	0.03607	-0.04792	-1.905	0.0569	
I34	-0.62399	1.04355	-2.66999	1.42201	-0.01575	-0.598	0.5499	
I35	1.10021	0.53800	0.04541	2.15500	0.05746	2.045	0.0409	I35 BV
I45	-1.91924	1.03035	-3.93936	0.10088	-0.04480	-1.863	0.0626	
Covariates								
GPA	3.37818	0.30120	2.78766	3.96871	0.17939	11.216	0.0000	GPA BV
SEX	-0.22323	0.25372	-0.72069	0.27422	-0.01408	-0.880	0.3790	
CONSTANT	9.95845	0.91883	8.15699	11.75992		10.838	0.0000	CONST BV

Appendix B (continued)

Regression Results for First-time Afro-American/Black Examinees

Quantitative Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	0.14789	0.33901	-0.51677	0.81255	0.01017	0.436	0.6627	
2.Do real GMAT	0.32668	0.68375	-1.01389	1.66725	0.02080	0.478	0.6328	
3.Non ETS book	1.56686	0.45118	0.68227	2.45145	0.12103	3.473	0.0005	Q3 BQ
4.Attnd course	1.31587	0.90177	-0.45216	3.08389	0.05182	1.459	0.1446	
5.Math review	-1.15403	0.52926	-2.19171	-0.11635	-0.08806	-2.180	0.0293	Q5 BQ
Question Interactions								
I12	-0.14276	0.69135	-1.49822	1.21270	-0.00857	-0.206	0.8364	
I13	-0.60987	0.49951	-1.58920	0.36947	-0.04470	-1.221	0.2222	
I14	-0.00581	0.89647	-1.76343	1.75181	-0.190D-03	-0.006	0.9948	
I15	-0.21011	0.53311	-1.25534	0.83511	-0.01536	-0.394	0.6935	
I23	0.38244	0.53395	-0.66443	1.42931	0.01675	0.716	0.4739	
I24	1.10477	0.88834	-0.63691	2.84646	0.02553	1.244	0.2137	
I25	-1.08454	0.52302	-2.10998	-0.05911	-0.05197	-2.074	0.0382	I25 BQ
I34	-2.55796	0.84473	-4.21415	-0.90177	-0.07947	-3.028	0.0025	I34 BQ
I35	0.55382	0.43549	-0.30001	1.40766	0.03560	1.272	0.2036	
I45	-0.29421	0.83405	-1.92944	1.34103	-0.00845	-0.353	0.7243	
Covariates								
GPA	1.93560	0.24381	1.45758	2.41361	0.12650	7.939	0.0000	GPA BQ
SEX	-2.52207	0.20538	-2.92475	-2.11940	-0.19582	-12.280	0.0000	SEX BQ
CONSTANT	15.00505	0.74377	13.54681	16.46329		20.174	0.0000	CONST BQ

Appendix B (continued)

Regression Results for First-time Afro-American/Black Examinees

Total Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	10.67799	4.68919	1.48433	19.87166	0.05316	2.277	0.0228	Q1 BT
2.Do real GMAT	4.38152	9.45770	-14.16131	22.92436	0.02019	0.463	0.6432	
3.Non ETS book	32.44641	6.24078	20.21070	44.68212	0.18135	5.199	0.0000	Q3 BT
4.Attnd course	23.14638	12.47338	-1.30901	47.60178	0.06596	1.856	0.0636	
5.Math review	-15.85016	7.32081	-30.20339	-1.49694	-0.08752	-2.165	0.0304	Q5 BT
Question Interactions								
I12	-2.44571	9.56276	-21.19451	16.30309	-0.01062	-0.256	0.7982	
I13	-15.09605	6.90921	-28.64230	-1.54980	-0.08007	-2.185	0.0290	I13 BT
I14	-3.82264	12.39999	-28.13414	20.48886	-0.00906	-0.308	0.7579	
I15	-4.05278	7.37405	-18.51040	10.40484	-0.02143	-0.550	0.5826	
I23	3.37200	7.38566	-11.10837	17.85237	0.01069	0.457	0.6480	
I24	21.74186	12.28756	-2.34921	45.83294	0.03635	1.769	0.0769	
I25	-15.40522	7.23444	-29.58912	-1.22133	-0.05341	-2.129	0.0333	I25 BT
I34	-19.82898	11.68439	-42.73748	3.07952	-0.04458	-1.697	0.0898	
I35	11.89275	6.02379	0.08248	23.70303	0.05531	1.974	0.0484	I35 BT
I45	-17.04826	11.53659	-39.66696	5.57045	-0.03544	-1.478	0.1396	
Covariates								
GPA	37.44553	3.37241	30.83356	44.05749	0.17708	11.103	0.0000	GPA BT
SEX	-17.08526	2.84089	-22.65512	-11.51540	-0.09599	-6.014	0.0000	SEX BT
CONSTANT	267.18767	10.28789	247.01717	287.35818		25.971	0.0000	CONST BT

Appendix C

Regression Results for First-time Caucasian/White Examinees

Verbal Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	1.63426	0.41812	0.81449	2.45404	0.09195	3.909	0.0001	Q1 WV
2.Do real GMAT	1.56122	0.90220	-0.20764	3.33008	0.08469	1.730	0.0836	
3.Non ETS book	1.60934	0.52896	0.57224	2.64643	0.10693	3.042	0.0024	Q3 WV
4.Attnd course	2.76152	1.08691	0.63051	4.89254	0.08976	2.541	0.0111	Q4 WV
5.Math review	-1.42029	0.76968	-2.92934	0.08877	-0.08376	-1.845	0.0651	
Question Interactions								
I12	-1.55530	0.91631	-3.35183	0.24123	-0.08079	-1.697	0.0897	
I13	-0.53445	0.59566	-1.70232	0.63341	-0.03456	-0.897	0.3697	
I14	-0.89006	1.12476	-3.09528	1.31516	-0.02445	-0.791	0.4288	
I15	0.23283	0.72303	-1.18474	1.65041	0.01289	0.322	0.7474	
I23	-0.51598	0.63312	-1.75729	0.72533	-0.01907	-0.815	0.4151	
I24	1.80391	1.06953	-0.29303	3.90086	0.03555	1.687	0.0918	
I25	-0.22680	0.67329	-1.54685	1.09326	-0.00774	-0.337	0.7362	
I34	-3.19729	1.05894	-5.27346	-1.12112	-0.08331	-3.019	0.0026	I34 WV
I35	0.25541	0.58387	-0.88934	1.40016	0.01321	0.437	0.6618	
I45	1.56307	1.05457	-0.50453	3.63068	0.03600	1.482	0.1384	
Covariates								
GPA	5.03132	0.28404	4.47443	5.58821	0.28842	17.714	0.0000	GPA WV
SEX	-0.01569	0.25247	-0.51069	0.47931	-0.00101	-0.062	0.9505	
CONSTANT	12.26115	0.93554	10.42692	14.09538		13.106	0.0000	CONST WV

Appendix C (continued)

Regression Results for First-time Caucasian/White Examinees

Quantitative Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	1.23059	0.43139	0.38479	2.07639	0.06684	2.853	0.0044	Q1 WQ
2.Do real GMAT	0.77377	0.93083	-1.05123	2.59877	0.04052	0.831	0.4059	
3.Non ETS book	1.20600	0.54575	0.13599	2.27601	0.07736	2.210	0.0272	Q3 WQ
4.Attnd course	2.16917	1.12141	-0.02948	4.36782	0.06807	1.934	0.0532	
5.Math review	-2.87355	0.79411	-4.43050	-1.31660	-0.16360	-3.619	0.0003	Q5 WQ
Question Interactions								
I12	-1.50617	0.94539	-3.35972	0.34737	-0.07552	-1.593	0.1112	
I13	-0.34042	0.61457	-1.54535	0.86452	-0.02125	-0.554	0.5797	
I14	-2.19544	1.16046	-4.47065	0.07978	-0.05821	-1.892	0.0586	
I15	0.84111	0.74597	-0.62146	2.30368	0.04496	1.128	0.2596	
I23	-0.89689	0.65322	-2.17759	0.38382	-0.03200	-1.373	0.1698	
I24	1.88160	1.10348	-0.28189	4.04510	0.03579	1.705	0.0883	
I25	0.86924	0.69466	-0.49272	2.23119	0.02865	1.251	0.2109	
I34	-1.01880	1.09254	-3.16086	1.12326	-0.02563	-0.932	0.3511	
I35	-0.07905	0.60240	-1.26013	1.10203	-0.00395	-0.131	0.8956	
I45	0.23971	1.08804	-1.89352	2.37294	0.00533	0.220	0.8256	
Covariates								
GPA	24.29832	0.29305	3.72375	4.87288	0.23787	14.667	0.0000	GPA WQ
SEX	-3.98515	0.26049	-4.49587	-3.47444	-0.24871	-15.299	0.0000	SEX WQ
CONSTANT	15.85585	0.96523	13.96341	17.74830		16.427	0.0000	CONST WQ

Appendix C (continued)

Regression Results for First-time Caucasian/White Examinees

Total Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	19.54058	5.04963	9.64019	29.44097	0.09063	3.870	0.0001	Q1 WT
2.Do real GMAT	16.42691	10.89575	-4.93549	37.78930	0.07345	1.508	0.1317	
3.Non ETS book	19.30030	6.38823	6.77543	31.82516	0.10571	3.021	0.0025	Q3 WT
4.Attnd course	33.58110	13.12652	7.84503	59.31717	0.08998	2.558	0.0106	Q4 WT
5.Math review	-28.36822	9.29538	-46.59289	-10.14355	-0.13792	-3.052	0.0023	Q5 WT
Question Interactions								
I12	-20.39623	11.06616	-42.09273	1.30027	-0.08733	-1.843	0.0654	
I13	-6.05852	7.19376	-20.16273	8.04568	-0.03230	-0.842	0.3997	
I14	-20.01995	13.58361	-46.65220	6.61231	-0.04532	-1.474	0.1406	
I15	6.45723	8.73193	-10.66273	23.57719	0.02947	0.739	0.4597	
I23	-9.55130	7.64616	-24.54249	5.43988	-0.02910	-1.249	0.2117	
I24	24.51315	12.91664	-0.81144	49.83774	0.03982	1.898	0.0578	
I25	3.38544	8.13121	-12.55676	19.32764	0.00953	0.416	0.6772	
I34	-30.20090	12.78866	-55.27457	-5.12723	-0.06487	-2.362	0.0183	I34 WT
I35	2.41771	7.05136	-11.40731	16.24274	0.01031	0.343	0.7317	
I45	14.22651	12.73593	-10.74377	39.19679	0.02701	1.117	0.2641	
Covariates								
GPA	64.28259	3.43030	57.55707	71.00810	0.30377	18.740	0.0000	GPA WT
SEX	-23.41606	3.04909	-29.39416	-17.43796	-0.12479	-7.680	0.0000	SEX WT
CONSTANT	289.37406	11.29839	267.22224	311.52588		25.612	0.0000	CONST WT

Appendix D

Regression Results for First-time Oriental/Asian Examinees

Verbal Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	1.44111	0.69726	0.07348	2.80873	0.07790	2.067	0.0389	Q1 OV
2.Do real GMAT	2.71226	1.54030	-0.30893	5.73345	0.12926	1.761	0.0785	
3.Non ETS book	3.24842	0.77835	1.72174	4.77509	0.19196	4.173	0.0000	Q3 OV
4.Attnd course	3.97552	1.41876	1.19272	6.75832	0.14826	2.802	0.0051	Q4 OV
5.Math review	-2.17887	1.08450	-4.30604	-0.05170	-0.11858	-2.009	0.0447	Q5 OV
Question Interactions								
I12	-3.52144	1.55508	-6.57162	-0.47127	-0.16091	-2.264	0.0237	I12 OV
I13	-1.61172	0.91238	-3.40129	0.17785	-0.09459	-1.767	0.0775	
I14	0.37866	1.48821	-2.54036	3.29768	0.01208	0.254	0.7992	
I15	0.74817	1.04755	-1.30653	2.80287	0.03758	0.714	0.4752	
I23	1.19852	1.05795	-0.87657	3.27361	0.04324	1.133	0.2574	
I24	-0.65403	1.40192	-3.40381	2.09574	-0.01641	-0.467	0.6409	
I25	0.78883	1.12771	-1.42309	3.00075	0.02364	0.699	0.4843	
I34	-3.23887	1.42095	-6.02597	-0.45177	-0.09868	-2.279	0.0228	I34 OV
I35	-0.56136	0.95575	-2.43600	1.31327	-0.02766	-0.587	0.5570	
I45	-1.55427	1.38513	-4.27110	1.16257	-0.03800	-1.122	0.2620	
Covariates								
GPA	6.10619	0.46588	5.19240	7.01997	0.30812	13.107	0.0000	GPA OV
SEX	-0.18542	0.40329	-0.97644	0.60560	-0.01089	-0.460	0.6457	
CONSTANT	5.60548	1.54310	2.57879	8.63217		3.633	0.0003	CONST OV

Appendix D (continued)

Regression Results for First-time Oriental/Asian Examinees

Quantitative Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	1.41949	0.68698	0.07203	2.76694	0.07640	2.066	0.0390	Q1 OQ
2.Do real GMAT	2.52371	1.51759	-0.45293	5.50035	0.11975	1.663	0.0965	
3.Non ETS book	1.70263	0.76687	0.19846	3.20680	0.10018	2.220	0.0265	Q3 OQ
4.Attnd course	0.54827	1.39784	-2.19350	3.29003	0.02036	0.392	0.6949	
5.Math review	-1.90464	1.06851	-4.00044	0.19116	-0.10321	-1.783	0.0749	
Question Interactions								
I12	-2.65822	1.53215	-5.66342	0.34698	-0.12094	-1.735	0.0829	
I13	-0.86608	0.89892	-2.62926	0.89710	-0.05061	-0.963	0.3355	
I14	1.03336	1.46626	-1.84262	3.90934	0.03281	0.705	0.4811	
I15	-1.62973	1.03210	-3.65413	0.39467	-0.08151	-1.579	0.1145	
I23	-0.08857	1.04235	-2.13306	1.95593	-0.00318	-0.085	0.9323	
I24	1.00281	1.38125	-1.70642	3.71204	0.02504	0.726	0.4679	
I25	0.36940	1.11108	-1.80991	2.54870	0.01102	0.332	0.7396	
I34	-1.29729	1.40000	-4.04330	1.44871	-0.03935	-0.927	0.3543	
I35	0.20440	0.94166	-1.64260	2.05139	0.01003	0.217	0.8282	
I45	-0.88286	1.36470	-3.55964	1.79391	-0.02149	-0.647	0.5178	
Covariates								
GPA	5.58289	0.45901	4.68258	6.48321	0.28050	12.163	0.0000	GPA OQ
SEX	-4.43413	0.39734	-5.21348	-3.65477	-0.25926	-11.160	0.0000	SEX OQ
CONSTANT	12.77205	1.52035	9.78999	15.75411		8.401	0.0000	CONST OQ

Appendix D (continued)

Regression Results for First-time Oriental/Asian Examinees

Total Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	19.19332	8.20997	3.09002	35.29662	0.08664	2.338	0.0195	Q1 OT
2.Do real GMAT	33.95997	18.13651	-1.61355	69.53350	0.13515	1.872	0.0613	
3.Non ETS book	34.50602	9.16480	16.52989	52.48216	0.17027	3.765	0.0002	Q3 OT
4.Attnd course	32.19020	16.70542	-0.57634	64.95673	0.10024	1.927	0.0542	
5.Math review	-28.57801	12.76960	-53.62471	-3.53131	-0.12987	-2.238	0.0254	Q5 OT
Question Interactions								
I12	-41.41934	18.31049	-77.32512	-5.49556	-0.15801	-2.262	0.0239	I12 OT
I13	-17.27765	10.74294	-38.34920	3.79389	-0.08467	-1.608	0.1080	
I14	8.18561	17.52316	-26.18486	42.55608	0.02180	0.467	0.6405	
I15	-3.68064	12.33455	-27.87402	20.51274	-0.01544	-0.298	0.7654	
I23	7.99806	12.45697	-16.43544	32.43156	0.02410	0.642	0.5209	
I24	3.33177	16.50717	-29.04591	35.70945	0.00698	0.202	0.8401	
I25	9.54443	13.27836	-16.50017	35.58903	0.02389	0.719	0.4724	
I34	-31.23408	16.73124	-64.05127	1.58310	-0.07946	-1.867	0.0621	
I35	-2.24646	11.25362	-24.31966	19.82674	-0.00924	-0.200	0.8418	
I45	-18.12824	16.30942	-50.11805	13.86157	-0.03701	-1.112	0.2665	
Covariates								
GPA	79.80757	5.48554	69.04806	90.56708	0.33628	14.549	0.0000	GPA OT
SEX	-27.18234	4.74857	-36.49633	-17.86835	-0.13329	-5.724	0.0000	SEX OT
CONSTANT	221.02055	18.16952	185.38229	256.65881		12.164	0.0000	CONST OT

Appendix E

Regression Results for First-time Spanish-American Examinees

Verbal Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	0.76684	0.76638	-0.73704	2.27072	0.04288	1.001	0.3173	
2.Do real GMAT	1.92703	1.72227	-1.45261	5.30666	0.09478	1.119	0.2635	
3.Non ETS book	2.50899	1.04289	0.46252	4.55545	0.15507	2.406	0.0163	Q3 SV
4.Attnd course	1.08892	2.07712	-2.98702	5.16487	0.03713	0.524	0.6002	
5.Math review	-0.96796	1.24060	-3.40240	1.46647	-0.05735	-0.780	20.4354	
Question Interactions								
I12	-0.88606	1.77853	-4.37608	2.60396	-0.04117	-0.498	0.6185	
I13	0.02480	1.16216	-2.25571	2.30531	0.00146	0.021	0.9830	
I14	1.57409	1.93448	-2.22196	5.37013	0.04371	0.814	0.4160	
I15	-1.33913	1.27476	-3.84061	1.16235	-0.07431	-1.050	0.2937	
I23	-0.45533	1.29107	-2.98882	2.07816	-0.01544	-0.353	0.7244	
I24	1.14878	1.93959	-2.65729	4.95485	0.02407	0.592	0.5538	
I25	-0.83859	1.32723	-3.44302	1.76584	-0.02828	-0.632	0.5276	
I34	-2.75941	1.93164	-6.54988	1.03106	-0.07729	-1.429	0.1534	
I35	0.83181	1.05813	-1.24458	2.90819	0.04219	0.786	0.4320	
I45	-0.03251	1.86745	-3.69704	3.63201	-0.828D-03	-0.017	0.9861	
Covariates								
GPA	5.44716	0.58520	4.29881	6.59550	0.28137	9.308	0.0000	GPA SV
SEX	-0.03211	0.50408	-1.02127	0.95705	-0.00195	-0.064	0.9492	
CONSTANT	6.31457	1.83759	2.70864	9.92050		3.436	0.0006	CONST SV

Appendix E (continued)

Regression Results for First-time Spanish-American Examinees

Quantitative Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	0.60334	0.68538	-0.74159	1.94828	0.03775	0.880	0.3789	
2.Do real GMAT	0.75690	1.54025	-2.26555	3.77934	0.04166	0.491	0.6232	
3.Non ETS book	1.62278	0.93266	-0.20740	3.45296	0.11224	1.740	0.0822	
4.Attnd course	1.10816	1.85759	-2.53700	4.75332	0.04228	0.597	0.5509	
5.Math review	-1.02522	1.10948	-3.20236	1.15193	-0.06797	-0.924	0.3557	
Question Interactions								
I12	0.72125	1.59056	-2.39991	3.84241	0.03750	0.453	0.6503	
I13	-0.84539	1.03933	-2.88487	1.19409	-0.05550	-0.813	0.4162	
I14	-0.51133	1.73002	-3.90617	2.88351	-0.01589	-0.296	0.7676	
I15	-0.19751	1.14003	-2.43461	2.03958	-0.01226	-0.173	0.8625	
I23	-0.09338	1.15462	-2.35910	2.17234	-0.00354	-0.081	0.9356	
I24	1.83215	1.73459	-1.57166	5.23596	0.04295	1.056	0.2911	
I25	-2.55261	1.18695	-4.88178	-0.22344	-0.09632	-2.151	0.0317	I25 SQ
I34	0.40045	1.72748	-2.98941	3.79030	0.01255	0.232	0.8167	
I35	0.15260	0.94630	-1.70433	2.00954	0.00866	0.161	0.8719	
I45	-3.22185	1.67008	-6.49907	0.05537	-0.09181	-1.929	0.0540	
Covariates								
GPA	3.71923	0.52335	2.69225	4.74620	0.21498	7.107	0.0000	GPA SQ
SEX	-3.25917	0.45080	-4.14379	-2.37456	-0.22092	-7.230	0.0000	SEX SQ
CONSTANT	12.58168	1.64338	9.35686	15.80650		7.656	0.0000	CONST SQ

Appendix E (continued)

Regression Results for First-time Spanish-American Examinees

Total Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	10.25137	8.82428	-7.06460	27.56734	0.04959	1.162	0.2456	
2.Do real GMAT	19.37683	19.83061	-19.53697	58.29064	0.08245	0.977	0.3287	
3.Non ETS book	29.80313	12.00801	6.23970	53.36657	0.15935	2.482	0.0132	Q3 ST
4.Attnd course	13.20169	23.91635	-33.72960	60.13297	0.03894	0.552	0.5811	
5.Math review	-13.69159	14.28448	-41.72216	14.33899	-0.07018	-0.958	0.3380	
Question Interactions								
I12	-1.53496	20.47833	-41.71978	38.64986	-0.00617	-0.075	0.9403	
I13	-5.13085	13.38129	-31.38910	21.12739	-0.02604	-0.383	0.7015	
I14	9.12349	22.27396	-34.58493	52.83190	0.02192	0.410	0.6822	
I15	-12.47829	14.67785	-41.28078	16.32420	-0.05990	-0.850	0.3954	
I23	-5.11052	14.86568	-34.28160	24.06055	-0.01499	-0.344	0.7311	
I24	20.91367	22.33279	-22.91018	64.73752	0.03790	0.936	0.3493	
I25	-21.78415	15.28196	-51.77209	8.20379	-0.06355	-1.425	0.1543	
I34	-19.36128	22.24124	-63.00549	24.28292	-0.04691	-0.871	0.3842	
I35	7.76305	12.18357	-16.14489	31.67098	0.03406	0.637	0.5242	
I45	-18.35629	21.50224	-60.55034	23.83776	-0.04044	-0.854	0.3935	
Covariates								
SEX	-19.04186	5.80406	-30.43123	-7.65250	-0.09979	-3.281	0.0011	SEX ST
GPA	63.87286	6.73812	50.65058	77.09514	0.28542	9.479	0.0000	GPA ST
CONSTANT	223.76046	21.15843	182.24106	265.27986		10.575	0.0000	CONST ST

Appendix F

Verbal Score Means for Response Categories by Significant Two-way Interactions:

First Time Examinees by Subgroup

Oriental/Asian

MEAN / STD DEV / COUNT	Q. 1 Do Actual GMAT: No	Yes	ROW TOTAL
Q. 1 Study Bulletin — No	26.02 / 8.46 / 440	29.09 / 9.09 / 34	26.24 / 8.53 / 474
Yes	26.46 / 8.14 / 868	26.49 / 8.93 / 293	26.47 / 8.34 / 1161
COLUMN TOTAL	26.31 / 8.25 / 1308	26.76 / 8.97 / 327	26.40 / 8.40 / 1635

Caucasian/White

MEAN / STD DEV / COUNT	Q. 4 Attend Course: No	Yes	ROW TOTAL
Q. 3 Use Other Book — No	28.93 / 7.62 / 1770	32.53 / 7.20 / 87	29.10 / 7.64 / 1857
Yes	29.97 / 7.38 / 1644	30.20 / 7.40 / 146	29.99 / 7.38 / 1790
COLUMN TOTAL	29.43 / 7.52 / 3414	31.07 / 7.40 / 233	29.53 / 7.52 / 3647

Afro-American/Black

MEAN / STD DEV / COUNT	Q. 5 Own Study of Math: No	Yes	ROW TOTAL
Q. 3 Use Other Book — No	20.47 / 7.55 / 1461	18.81 / 7.78 / 660	19.95 / 7.66 / 2121
Yes	22.64 / 7.90 / 783	21.78 / 8.07 / 801	22.21 / 7.99 / 1584
COLUMN TOTAL	21.23 / 7.74 / 2244	20.44 / 8.08 / 1461	20.92 / 7.88 / 3705

Afro-American/Black

MEAN / STD DEV / COUNT	Q. 3 Use Other Book: No	Yes	ROW TOTAL
Q. 1 Study Bulletin — No	19.31 / 7.69 / 608	22.63 / 7.77 / 369	20.56 / 7.88 / 977
Yes	20.22 / 7.63 / 1513	22.08 / 8.06 / 1215	21.05 / 7.88 / 2728
COLUMN TOTAL	19.95 / 7.66 / 2121	22.21 / 7.99 / 1584	20.92 / 7.88 / 3705

Oriental/Asian

MEAN / STD DEV / COUNT	Q. 4 Attend Course: No	Yes	ROW TOTAL
Q. 3 Use Other Book — No	25.01 / 8.06 / 649	29.02 / 8.80 / 65	25.37 / 8.20 / 714
Yes	27.22 / 8.40 / 806	27.04 / 8.88 / 115	27.20 / 8.46 / 921
COLUMN TOTAL	26.23 / 8.32 / 1455	27.76 / 8.88 / 180	26.40 / 8.40 / 1635

Appendix F (continued)

Quantitative Score Means for Response Categories by Significant Two-way Interactions:
First Time Examinees by Subgroup

Afro-American/Black

MEAN / STD DEV / COUNT	Q. 5 Own Study of Math: No	Q. 5 Own Study of Math: Yes	ROW TOTAL
Q. 2 Do Actual GMAT: No	19.72 / 6.69 / 1853	18.79 / 5.72 / 1071	19.37 / 6.37 / 2924
Q. 2 Do Actual GMAT: Yes	19.95 / 6.88 / 391	18.06 / 6.04 / 390	19.01 / 6.54 / 781
COLUMN TOTAL	19.76 / 6.72 / 2244	18.59 / 5.82 / 1461	19.30 / 6.41 / 3705

Spanish-American

MEAN / STD DEV / COUNT	Q. 5 Own Study of Math: No	Q. 5 Own Study of Math: Yes	ROW TOTAL
Q. 2 Do Actual GMAT: No	23.42 / 7.20 / 557	22.19 / 6.52 / 274	23.01 / 7.00 / 831
Q. 2 Do Actual GMAT: Yes	25.24 / 8.19 / 117	20.52 / 6.54 / 82	23.30 / 7.89 / 199
COLUMN TOTAL	23.73 / 7.41 / 674	21.81 / 6.55 / 356	23.07 / 7.18 / 1030

Afro-American/Black

MEAN / STD DEV / COUNT	Q. 4 Attend Course: No	Q. 4 Attend Course: Yes	ROW TOTAL
Q. 3 Use Other Book: No	18.82 / 6.24 / 2021	19.91 / 6.78 / 100	18.87 / 6.27 / 2121
Q. 3 Use Other Book: Yes	20.00 / 6.66 / 1431	18.67 / 5.12 / 153	19.87 / 6.54 / 1584
COLUMN TOTAL	19.31 / 6.44 / 3452	19.16 / 5.86 / 253	19.30 / 6.41 / 3705

Appendix F (continued)

Total Score Means for Response Categories by Significant Two-way Interactions:

First Time Examinees by Subgroup

Oriental/Asian

MEAN / STD DEV / COUNT	Q. 2 Do Actual GMAT: No	Yes	ROW TOTAL
Q. 1 Study Bulletin — No	472.61 / 98.15 / 440	510.59 / 115.60 / 34	475.34 / 99.84 / 474
Yes	477.86 / 97.40 / 868	477.41 / 110.68 / 293	477.74 / 100.86 / 1161
COLUMN TOTAL	476.09 / 97.64 / 1308	480.86 / 111.48 / 327	477.05 / 100.54 / 1635

Afro-American/Black

MEAN / STD DEV / COUNT	Q. 5 Own Study of Math: No	Yes	ROW TOTAL
Q. 2 Do Actual GMAT — No	380.81 / 88.77 / 1853	371.70 / 84.82 / 1071	377.47 / 87.44 / 2924
Yes	385.52 / 92.40 / 391	360.44 / 90.88 / 390	373.00 / 92.44 / 781
COLUMN TOTAL	381.63 / 89.41 / 2244	368.69 / 86.59 / 1461	376.53 / 88.52 / 3705

Afro-American/Black

MEAN / STD DEV / COUNT	Q. 5 Own Study of Math: No	Yes	ROW TOTAL
Q. 3 Use Other Book — No	373.73 / 86.34 / 1461	350.97 / 82.68 / 660	366.65 / 85.85 / 2121
Yes	396.37 / 93.16 / 783	383.30 / 87.06 / 801	389.76 / 90.34 / 1584
COLUMN TOTAL	381.63 / 89.41 / 2244	368.69 / 86.59 / 1461	376.53 / 88.52 / 3705

Afro-American/Black

MEAN / STD DEV / COUNT	Q. 3 Use Other Book: No	Yes	ROW TOTAL
Q. 1 Study Bulletin — No	362.32 / 87.32 / 608	395.93 / 90.01 / 369	375.02 / 89.79 / 977
Yes	368.39 / 85.22 / 1513	387.88 / 90.39 / 1215	377.07 / 88.08 / 2728
COLUMN TOTAL	366.65 / 85.85 / 2121	389.76 / 90.34 / 1584	376.53 / 88.52 / 3705

Caucasian/White

MEAN / STD DEV / COUNT	Q. 4 Attend Course: No	Yes	ROW TOTAL
Q. 3 Use Other Book — No	491.27 / 92.83 / 1770	526.44 / 85.59 / 87	492.91 / 92.78 / 1857
Yes	500.91 / 89.84 / 1644	500.27 / 86.53 / 146	500.85 / 89.55 / 1790
COLUMN TOTAL	495.91 / 91.51 / 3414	510.04 / 86.93 / 233	496.81 / 91.28 / 3647

Appendix G

Number of Examinees Responding 'Yes' and 'No' with First and Second Verbal, Quantitative and Total Score Means and Mean GPA, Age and Work Experience: Second-time Examinees

	Second Verbal Score		Quantitative Score		Second Total Score		Number of Examinees	
MEAN STD DEV	No	Yes	No	Yes	No	Yes	No	Yes
Q. 1 Study Bulletin	26.99 7.43	27.19 7.67	26.10 7.01	26.15 7.31	463.54 86.38	465.44 90.37	2724 31.5%	5912 68.5%
Q. 2 Do Actual GMAT	26.95 7.54	27.53 7.72	26.00 7.06	26.42 7.56	462.75 87.55	469.60 92.48	6004 69.5%	2632 30.5%
Q. 3 Use Other Book	26.06 7.68	27.80 7.47	25.55 7.33	26.50 7.12	453.22 91.00	472.19 87.14	3346 38.7%	5290 61.3%
Q. 4 Attend Course	26.85 7.55	28.51 7.66	26.08 7.16	26.37 7.48	462.42 88.46	476.89 91.47	7195 83.3%	1441 16.7%
Q. 5 Own Study of Math	27.04 7.52	27.24 7.71	26.68 7.40	25.35 6.88	467.40 89.83	461.17 88.01	5083 58.9%	3553 41.1%
Non- Respondents	25.96 7.75		25.24 7.19		450.61 90.64		5359 62.1%(Total Group)	
	First Verbal Score		Quantitative Score		First Total Score			
Q. 1 Study Bulletin	24.09 6.80	24.41 7.07	23.94 6.58	23.93 6.76	428.33 77.05	430.93 80.67		
Q. 2 Do Actual GMAT	24.28 6.95	24.37 7.07	23.97 6.63	23.86 6.87	430.04 78.79	430.28 81.28		
Q. 3 Use Other Book	23.49 7.04	24.82 6.91	23.47 6.83	24.23 6.61	421.05 81.74	435.84 77.60		
Q. 4 Attend Course	24.26 7.02	24.56 6.80	24.03 6.72	23.44 6.62	430.27 80.10	429.31 76.81		
Q. 5 Own Study of Math	24.17 6.87	24.51 7.15	24.69 6.88	22.85 6.30	433.26 79.97	425.61 78.74		
Non- Respondents	23.25 7.03		23.23 6.60		417.62 79.65			

Appendix G (continued)

Number of Examinees Responding 'Yes' and 'No' with First and Second Verbal, Quantitative and Total Score Means and Mean GPA, Age and Work Experience: Second-time Examinees

	Verbal Gain (2-1)		Quantitative Gain		Total Gain (2-1)		Number of Examinees	
MEAN STD DEV	No	Yes	No	Yes	No	Yes	No	Yes
Q. 1 Study Bulletin	2.90 5.21	2.78 5.20	2.16 4.58	2.21 4.60	35.20 49.35	34.51 49.20	2724 31.5%	5912 68.5%
Q. 2 Do Actual GMAT	2.67 5.17	3.16 5.27	2.04 4.57	2.56 4.64	32.71 48.61	39.31 50.36	6004 69.5%	2632 30.5%
Q. 3 Use Other Book	2.57 5.17	2.98 5.22	2.08 4.63	2.27 4.57	32.17 48.92	36.34 49.38	3346 38.7%	5290 61.3%
Q. 4 Attend Course	2.59 5.12	3.94 5.45	2.05 4.55	2.93 4.75	32.15 48.05	47.58 52.98	7195 83.3%	1441 16.7%
Q. 5 Own Study of Math	2.88 5.14	2.73 5.29	1.99 4.60	2.49 4.57	34.14 48.68	35.57 50.04	5083 58.9%	3553 41.1%
Non- Respondents	2.70 5.27		2.00 4.54		33.00 50.64		5359 62.1%(Total Group)	
	Undergraduate G.P.A.		AGE in 1982		Mos. Work Experience			
Q. 1 Study Bulletin N of Examinees	2.986 0.404 2724	2.998 0.423 5912	25.99 4.15 2722	26.50 4.55 5901	34.58 30.76 2597	38.40 32.16 5643		
Q. 2 Do Actual GMAT N of Examinees	2.983 0.415 6004	3.020 0.419 2632	26.39 4.44 5996	26.21 4.42 2627	37.56 31.85 5746	36.36 31.58 2494		
Q. 3 Use Other Book N of Examinees	2.962 0.408 3346	3.015 0.421 5290	26.52 4.60 3341	26.22 4.32 5282	38.93 32.53 3190	36.10 31.23 5050		
Q. 4 Attend Course N of Examinees	2.986 0.421 7195	3.037 0.390 1441	26.35 4.41 7185	26.27 4.57 1438	37.47 31.95 6872	35.82 30.85 1368		
Q. 5 Own Study of Math N of Examinees	2.982 0.421 5083	3.012 0.410 3553	26.09 4.26 5077	26.70 4.65 3546	35.90 31.30 4825	39.03 32.35 3415		
Non- Respondents N of Examinees	2.971 0.405 5359		27.03 4.88 5348		35.83 31.53 5097			

Appendix H

Regression Results for Second-time Examinees

Verbal Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	-0.06043	0.21000	-0.47208	0.35121	-0.00370	-0.288	0.7735	
2.Do real GMAT	0.46078	0.29506	-0.11761	1.03916	0.02792	1.562	0.1184	
3.Non ETS book	0.92468	0.21571	0.50182	1.34753	0.05930	4.287	0.0000	Q3
4.Attnd course	1.89694	0.30540	1.29829	2.49560	0.09311	6.211	0.0000	Q4
5.Math review	-0.27753	0.28264	-0.83156	0.27651	-0.01798	-0.982	0.3262	
Question Interactions								
I12	0.29810	0.29342	-0.27708	0.87327	0.01704	1.016	0.3097	
I13	-0.27919	0.24850	-0.76631	0.20793	-0.01822	-1.124	0.2613	
I14	-0.09737	0.31727	-0.71930	0.52456	-0.00389	-0.307	0.7589	
I15	0.31631	0.25596	-0.18543	0.81804	0.01936	1.236	0.2166	
I23	0.18854	0.25062	-0.30273	0.67980	0.00936	0.752	0.4519	
I24	0.28626	0.30977	-0.32097	0.89349	0.00939	0.924	0.3555	
I25	-0.93623	0.24910	-1.42452	-0.44794	-0.04414	-3.759	0.0002	I25
I34	-0.97531	0.31528	-1.59333	-0.35729	-0.04034	-3.093	0.0020	I34
I35	0.03005	0.24136	-0.44307	0.50317	0.00182	0.125	0.9009	
I45	-0.01990	0.30649	-0.62069	0.58089	-0.00074	-0.065	0.9482	
Covariates								
First Verb	0.75805	0.00825	0.74187	0.77422	0.69723	91.870	0.0000	Verb
GPA	1.73510	0.13496	1.47054	1.99965	0.09518	12.857	0.0000	GPA
SEX	-0.18307	0.11425	-0.40704	0.04089	-0.01159	-1.602	0.1091	
SUB1[a]	-1.86613	0.20568	-2.26931	-1.46295	-0.06647	-9.073	0.0000	SUB1
SUB3	-1.65008	0.38331	-2.40146	-0.89869	-0.03017	-4.305	0.0000	SUB3
SUB4	-1.03980	0.28868	-1.60567	-0.47392	-0.02518	-3.602	0.0003	SUB4
CONSTANT	3.06713	0.42668	2.23073	3.90352		7.188	0.0000	CONSTANT

[a]Subgroup 2 (Caucasian/White) is the reference group.

Appendix H (continued)

Regression Results for Second-time Examinees

Quantitative Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	-0.00253	0.18729	-0.36965	0.36460	-0.00016	-0.013	0.9892	
2.Do real GMAT	0.06466	0.26308	-0.45105	0.58037	0.00413	0.246	0.8059	
3.Non ETS book	0.43828	0.19242	0.06109	0.81548	0.02959	2.278	0.0228	Q3
4.Attnd course	1.26913	0.27235	0.73527	1.80299	0.06558	4.660	0.0000	Q4
5.Math review	0.08903	0.25215	-0.40525	0.58330	0.00607	0.353	0.7240	
Question Interactions								
I12	0.25989	0.26168	-0.25306	0.77285	0.01564	0.993	0.3207	
I13	-0.17816	0.22161	-0.61257	0.25624	-0.01224	-0.804	0.4214	
I14	0.00222	0.28289	-0.55231	0.55674	0.00009	0.008	0.9938	
I15	0.05295	0.22820	-0.39437	0.50028	0.00341	0.232	0.8165	
I23	0.04218	0.22350	-0.39594	0.48031	0.00220	0.189	0.8503	
I24	0.68258	0.27633	0.14091	1.22425	0.02357	2.470	0.0135	I24
I25	0.00392	0.22217	-0.43159	0.43943	0.00019	0.018	0.9859	
I34	-0.80177	0.28113	-1.35286	-0.25069	-0.03491	-2.852	0.0044	I34
I35	0.06022	0.21523	-0.36169	0.48213	0.00384	0.280	0.7796	
I45	-0.67157	0.27329	-1.20728	-0.13587	-0.02618	-2.457	0.0140	I45
Covariates								
First Quant	0.79594	0.00769	0.78087	0.81101	0.73985	103.518	0.0000	Quant
GPA	1.25841	0.11938	1.02439	1.49243	0.07268	10.541	0.0000	GPA
SEX	-0.65922	0.10345	-0.86201	-0.45642	-0.04394	-6.372	0.0000	SEX
SUB1[a]	-2.10334	0.18234	-2.46076	-1.74591	-0.07888	-11.535	0.0000	SUB1
SUB3	-1.67973	0.34158	-2.34930	-1.01015	-0.03234	-4.918	0.0000	SUB3
SUB4	-0.39373	0.25734	-0.89818	0.11071	-0.01004	-1.530	0.1260	
CONSTANT	3.30194	0.38928	2.53885	4.06503		8.482	0.0000	CONSTANT

[a]Subgroup 2 (Caucasian/White) is the reference group.

Appendix H (continued)

Regression Results for Second-time Examinees

Total Score

VARIABLE	B	SE B	95% CONFDNCE INTRVL B		BETA	T	SIG T	VARIABLE
Question Main Effects								
1.Study bull.	-0.82579	2.04245	-4.82948	3.17790	-0.00431	-0.404	0.6860	
2.Do real GMAT	4.01518	2.86919	-1.60912	9.63948	0.02074	1.399	0.1617	
3.Non ETS book	8.68991	2.09843	4.57649	12.80333	0.04750	4.141	0.0000	Q3
4.Attnd course	22.00002	2.97002	16.17807	27.82197	0.09204	7.407	0.0000	Q4
5.Math review	-1.81324	2.74817	-7.20030	3.57382	-0.01001	-0.660	0.5094	
Question Interactions								
I12	4.48095	2.85363	-1.11285	10.07475	0.02183	1.570	0.1164	
I13	-3.57657	2.41667	-8.31382	1.16068	-0.01989	-1.480	0.1389	
I14	-1.99063	3.08508	-8.03813	4.05687	-0.00677	-0.645	0.5188	
I15	3.76539	2.48929	-1.11420	8.64499	0.01965	1.513	0.1304	
I23	0.78950	2.43754	-3.98866	5.56766	0.00334	0.324	0.7460	
I24	5.61820	3.01303	-0.28806	11.52446	0.01570	1.865	0.0623	
I25	-7.08800	2.42253	-11.83672	-2.33927	-0.02848	-2.926	0.0034	I25
I34	-10.91818	3.06641	-16.92907	-4.90729	-0.03849	-3.561	0.0004	I34
I35	0.34341	2.34723	-4.25771	4.94453	0.00177	0.146	0.8837	
I45	-2.82978	2.98054	-8.67236	3.01279	-0.00893	-0.949	0.3424	
Covariates								
First Total	0.88847	0.00714	0.87448	0.90247	0.79300	124.463	0.0000	Total
GPA	14.99255	1.32129	12.40250	17.58259	0.07010	11.347	0.0000	GPA
SEX	-5.82049	1.10556	-7.98765	-3.65334	-0.03141	-5.265	0.0000	SEX
SUB1[a]	-17.65614	2.02010	-21.61601	-13.69627	-0.05361	-8.740	0.0000	SUB1
SUB3	-17.06862	3.73153	-24.38330	-9.75394	-0.02660	-4.574	0.0000	SUB3
SUB4	-9.04860	2.80283	-14.54282	-3.55438	-0.01868	-3.228	0.0012	SUB4
CONSTANT	34.42167	4.52459	25.55239	43.29095		7.608	0.0000	CONSTANT

[a]Subgroup 2 (Caucasian/White) is the reference group.

Appendix I

Verbal Means for Response Categories by Significant Two-way Interactions: Second-Time Examinees

	MEAN STD DEV COUNT	Q. 4 Attend Course No	 Yes	ROW TOTAL
Q. 3 Use Other Book	No	25.63 7.53 2864	28.65 8.05 482	26.06 7.68 3346
	Yes	27.66 7.46 4331	28.44 7.46 959	27.80 7.47 5290
COLUMN TOTAL		26.85 7.55 7195	28.51 7.66 1441	27.13 7.60 8636

	MEAN STD DEV COUNT	Q. 5 Own Study of Math No	 Yes	ROW TOTAL
Q. 2 Do Actual GMAT	No	26.82 7.47 3756	27.17 7.64 2248	26.95 7.54 6004
	Yes	27.68 7.64 1327	27.38 7.81 1305	27.53 7.72 2632
COLUMN TOTAL		27.04 7.52 5083	27.24 7.71 3553	27.13 7.60 8636

Appendix I (continued)

Quantitative Means for Response Categories by

Significant Two-way Interactions: Second-Time Examinees

MEAN / STD DEV / COUNT	Q. 2 Do Actual GMAT: No	Q. 2 Do Actual GMAT: Yes	ROW TOTAL
Q. 4 Attend Course: No	26.06 7.05 5137	26.14 7.42 2058	26.08 7.16 7195
Q. 4 Attend Course: Yes	25.69 7.07 867	27.41 7.95 574	26.37 7.48 1441
COLUMN TOTAL	26.00 7.06 6004	26.42 7.56 2632	26.13 7.22 8636

MEAN / STD DEV / COUNT	Q. 3 Use Other Book: No	Q. 3 Use Other Book: Yes	ROW TOTAL
Q. 4 Attend Course: No	25.33 7.16 2864	26.58 7.12 4331	26.08 7.16 7195
Q. 4 Attend Course: Yes	26.83 8.16 482	26.14 7.10 959	26.37 7.48 1441
COLUMN TOTAL	25.55 7.33 3346	26.50 7.12 5290	26.13 7.22 8636

MEAN / STD DEV / COUNT	Q. 5 Own Study of Math: No	Q. 5 Own Study of Math: Yes	ROW TOTAL
Q. 4 Attend Course: No	26.55 7.35 4390	25.34 6.79 2805	26.08 7.16 7195
Q. 4 Attend Course: Yes	27.46 7.61 693	25.37 7.21 748	26.37 7.48 1441
COLUMN TOTAL	26.68 7.40 5083	25.35 6.88 3553	26.13 7.22 8636

Appendix I (continued)

Total Means for Response Categories by Significant Two-way Interactions: Second-Time Examinees

	MEAN STD DEV COUNT	Q. 4 Attend Course No	 Yes	ROW TOTAL
Q. 3 Use Other Book	No	448.58 88.73 2864	480.81 99.18 482	453.22 91.00 3346
	Yes	471.58 87.09 4331	474.92 87.33 959	472.19 87.14 5290
COLUMN TOTAL		462.42 88.46 7195	476.89 91.47 1441	464.84 89.13 8636

	MEAN STD DEV COUNT	Q. 5 Own Study of Math No	 Yes	ROW TOTAL
Q. 2 Do Actual GMAT	No	464.57 88.22 3756	459.71 86.34 2248	462.75 87.55 6004
	Yes	475.40 93.81 1327	463.69 90.77 1305	469.60 92.48 2632
COLUMN TOTAL		467.40 89.83 5083	461.17 88.01 3553	464.84 89.13 8636